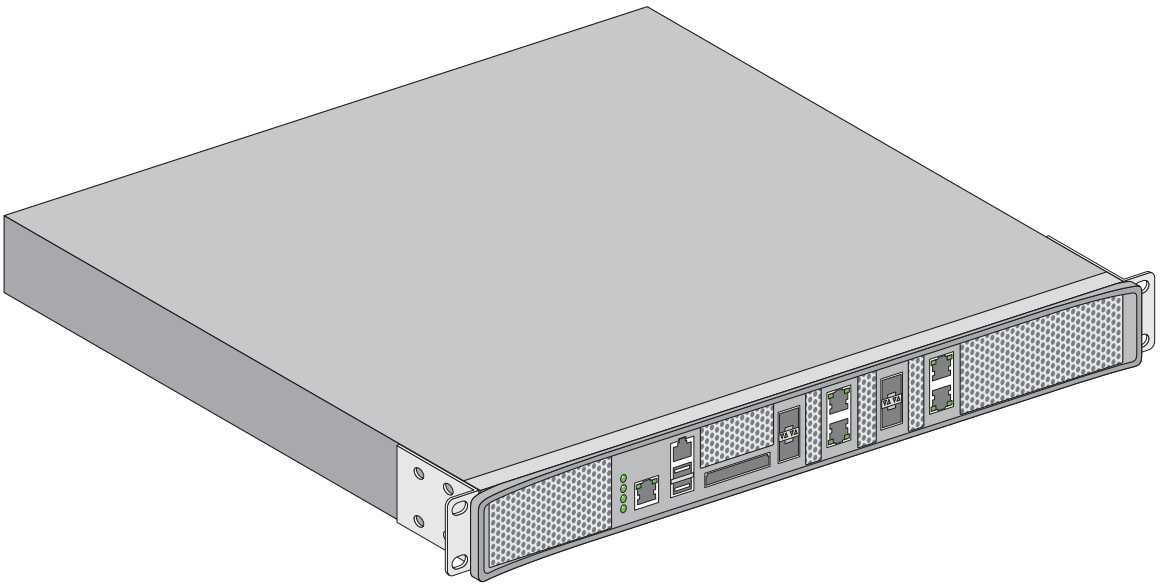
MOTOROLA

RFS7000 Series RF Switch

System Reference Guide



MOTOROLA and the Stylized M Logo are registered in the US Patent & Trademark Office. Symbol is a registered trademark of Symbol Technologies, Inc. All other product or service names are the property of their respective owners. © Motorola, Inc. 2008. All rights reserved.

Introduction

This guide provides information about using the RFS7000 Series RF Switch.

NOTE Screens and windows pictured in this guide are samples and can differ from actual screens.

Documentation Set

The documentation set for the RFS7000 Series Switch is partitioned into the following guides to provide information for specific user needs.

- **RFS7000 Installation Guide** - describes the basic setup and configuration required to transition to more advanced configuration of the switch.
- **RFS7000 CLI Reference** - describes the *Command Line Interface* (CLI) commands used to configure the RFS7000 switch.
- **RFS7000 Troubleshooting Guide** - describes workarounds to known conditions the user may encounter.

Document Conventions

The following conventions are used in this document to draw your attention to important information:

NOTE Indicate tips or special requirements.

CAUTION Indicates conditions that can cause equipment damage or data loss.

WARNING! Indicates a condition or procedure that could result in personal injury or equipment damage.

Notational Conventions

The following additional notational conventions are used in this document:

- *Italics* are used to highlight the following:
  - Chapters and sections in this and related documents
  - Dialog box, window and screen names
  - Drop-down list and list box names
  - Check box and radio button names
  - Icons on a screen.
- **GUI** text is used to highlight the following:
  - Screen names
  - Menu items
  - Button names on a screen.
- bullets (•) indicate:
  - Action items
  - Lists of alternatives
  - Lists of required steps that are not necessarily sequential
- Sequential lists (e.g., those that describe step-by-step procedures) appear as numbered lists.

Contents

Chapter 1. Overview

Hardware Overview 1-1
- Physical Specifications 1-2
  - Power Cord Specifications 1-2
  - Power Protection 1-2
  - Cabling Requirements 1-3
- System Status LED Codes 1-4
  - System Status LEDs 1-4
  - RJ-45 Gigabit Ethernet LEDs 1-6
  - SFP Gigabit Ethernet LEDs 1-6
  - Out of Band Management Port LEDs 1-7

Software Overview 1-7
- Infrastructure Features 1-8
  - Installation Feature 1-8
  - Licensing Support 1-8
  - Configuration Management 1-9
  - Diagnostics 1-9
  - Serviceability 1-9
  - Tracing / Logging 1-9
  - Process Monitor 1-10
  - Hardware Abstraction Layer and Drivers 1-10
  - Redundancy 1-10
  - Secure Network Time Protocol (SNTP) 1-10
  - Password Recovery 1-11
- Wireless Switching 1-11
  - Adaptive AP 1-11
  - Physical Layer Features 1-12
  - Proxy-ARP 1-13
  - Hotspot / IP Redirect 1-13
  - IDM (Identity Driven Management) 1-14
  - Voice Prioritization 1-14
  - Self Healing 1-14
  - Wireless Capacity 1-15
  - AP and MU Load Balancing 1-15
  - Wireless Roaming 1-16

Power Save Polling 1-17
QoS 1-17
Wireless Layer 2 Switching 1-18
Automatic Channel Selection 1-19
WMM-Unscheduled APSD 1-19
Multiple VLANs per WLAN 1-19
Wired Switching 1-21
DHCP Servers 1-21
DDNS 1-21
VLAN Enhancements 1-21
Interface Management 1-22
Management Features 1-22
Security Features 1-22
Encryption and Authentication 1-23
MU Authentication 1-23
Secure Beacon 1-24
MU to MU Allow 1-24
MU to MU Disallow 1-24
Switch - to - Wired 1-24
802.1x Authentication 1-24
WIPS 1-25
Rogue AP Detection 1-26
ACLs 1-27
Local Radius Server 1-27
IPSec VPN 1-27
NAT 1-28
Firewall 1-28
Certificate Management 1-29
NAC 1-30
Access Port Support 1-30

Chapter 2. Switch Web UI Access & Image Upgrades

Accessing the Switch Web UI 2-1
Web UI Requirements 2-1
Connecting to the Switch Web UI 2-2
Switch Password Recovery 2-3

Chapter 3. Switch Information

Viewing the Switch Interface 3-1
Viewing the Switch Configuration 3-2
Viewing Dashboard Details 3-4
Viewing Switch Statistics 3-6
Viewing Switch Port Information 3-8
Viewing the Port Configuration 3-8
Editing the Port Configuration 3-10
Viewing the Ports Runtime Status 3-11

Viewing the Ports Statistics 3-12
Detailed Port Statistics 3-13
Viewing the Port Statistics Graph 3-15
Viewing Switch Configurations 3-16
Viewing the Detailed Contents of a Config File 3-17
Transferring a Config File 3-18
Viewing Switch Firmware Information 3-21
Editing the Switch Firmware 3-22
Updating the Switch Firmware 3-23
Switch File Management 3-25
Transferring Files 3-25
Transferring a file from Wireless Switch to Wireless Switch 3-26
Transferring a file from a Wireless Switch to a Server 3-27
Transferring a file from a Server to a Wireless Switch 3-27
Viewing Files 3-29
Configuring Automatic Updates 3-30
Viewing the Switch Alarm Log 3-32
Viewing Alarm Log Details 3-34
Viewing Switch Licenses 3-36
How to use the Filter Option 3-37

Chapter 4. Network Setup

Displaying the Network Interface 4-2
Viewing Network IP Information 4-4
Configuring DNS 4-4
Adding an IP Address for a DNS Server 4-5
Configuring Global Settings 4-5
Configuring IP Forwarding 4-6
Adding a New Static Route 4-7
Viewing Address Resolution 4-8
Viewing and Configuring Layer 2 Virtual LANs 4-9
Viewing and Configuring VLANs by Port 4-9
Editing the Details of an Existing VLAN 4-10
Viewing and Configuring Ports by VLAN 4-11
Editing a VLAN by Port Designation 4-12
Configuring Switch Virtual Interfaces 4-13
Configuring the Virtual Interface 4-14
Adding a Virtual Interface 4-15
Modifying a Virtual Interface 4-16
Viewing Virtual Interface Statistics 4-17
Viewing Virtual Interface Statistics 4-20
Viewing the Virtual Interface Statistics Graph 4-21
Viewing and Configuring Switch WLANs 4-23
Configuring WLANs 4-23
Editing the WLAN Configuration 4-27
Assigning Multiple VLANs per WLAN 4-31

Configuring Authentication Types 4-33
Configuring Different Encryption Types 4-50
Viewing WLAN Statistics 4-55
Viewing WLAN Statistics Details 4-56
Viewing WLAN Statistics in a Graphical Format 4-59
Viewing WLAN Switch Statistics 4-60
Configuring WMM 4-61
Editing WMM Setting 4-65
Configuring the NAC Inclusion List 4-66
Adding an Include List to a WLAN 4-68
Configuring Devices on the Include List 4-68
Mapping Include List Items to WLANs 4-69
Configuring the NAC Exclusion List 4-70
Adding an Exclude List to the WLAN 4-71
Configuring Devices on the Exclude List 4-71
Mapping Exclude List Items to WLANs 4-72
NAC Configuration Examples Using the Switch CLI 4-73
Creating an Include List 4-73
Creating an Exclude List 4-74
Configuring the WLAN for NAC 4-74
Viewing Associated MUs 4-76
Viewing MU Status 4-76
Viewing MU Details 4-77
Viewing MU Statistics 4-79
Viewing MU Statistics Details 4-80
View a MU Statistics Graph 4-82
Viewing Access Port Radio Information 4-84
Configuring Access Port Radios 4-84
Configuring an AP's Global Settings 4-86
Editing AP Settings 4-88
Adding APs 4-93
Viewing AP Statistics 4-94
Viewing APs Details 4-96
Viewing an AP's Graph 4-98
Configuring WLAN Assignment 4-99
Editing a WLAN Assignment 4-100
Configuring WMM 4-101
Editing WMM Settings 4-103
Reviewing Bandwidth Settings 4-104
Viewing Access Port Adoption Defaults 4-105
Configuring AP Adoption Defaults 4-105
Editing Default Radio Adoption Settings 4-107
Configuring Layer 3 Access Port Adoption 4-112
Configuring WLAN Assignment 4-113
Configuring WMM 4-115
Editing Access Port Adoption WMM Settings 4-116

Viewing Access Port Status 4-117
Viewing Adopted Access Ports 4-117
Viewing Unadopted Access Ports 4-119
Multiple Spanning Tree 4-120
Configuring a Bridge 4-122
Viewing and Configuring Bridge Instance Details 4-125
Creating a Bridge Instance 4-125
Associating VLANs to a Bridge Instance 4-126
Configuring a Port 4-126
Editing a MST Port Configuration 4-130
Viewing and Configuring Port Instance Details 4-131
Editing a Port Instance Configuration 4-133

Chapter 5. Switch Services

Displaying the Services Interface 5-2
DHCP Server Settings 5-4
Configuring the Switch DHCP Server 5-4
Editing the Properties of an Existing DHCP Pool 5-6
Adding a New DHCP Pool 5-7
Configuring DHCP Global Options 5-9
Configuring DHCP Server DDNS Values 5-10
Configuring Existing Host Pools 5-11
Configuring Excluded IP Address Information 5-12
Configuring DHCP Server Relay Information 5-13
Viewing DDNS Bindings 5-15
Viewing DHCP Bindings 5-16
Reviewing DHCP Dynamic Bindings 5-18
Configuring DHCP User Class 5-19
Adding a New DHCP User Class Name 5-20
Editing the Properties of an Existing DHCP User Class Name 5-20
Configuring DHCP Pool Class 5-22
Editing an Existing DHCP Pool Class Name 5-23
Adding a New DHCP Pool Class Name 5-23
Configuring Secure NTP 5-24
Defining the Secure NTP Configuration 5-24
Configuring Symmetric Keys 5-26
Adding a New SNTP Symmetric Key 5-27
Defining a NTP Neighbor Configuration 5-28
Adding an NTP Neighbor 5-30
Viewing NTP Associations 5-31
Viewing NTP Status 5-34
Configuring Switch Redundancy 5-35
Reviewing Redundancy Status 5-39
Configuring Redundancy Group Membership 5-41
Displaying Redundancy Member Details 5-43
Adding a Redundancy Group Member 5-45
Redundancy Group License Aggregation Rules 5-45

Layer 3 Mobility 5-46
Configuring Layer 3 Mobility 5-46
Defining the Layer 3 Peer List 5-49
Reviewing Layer 3 Peer List Statistics 5-50
Reviewing Layer 3 MU Status 5-51
Configuring Self Healing 5-53
Configuring Self Healing Neighbor Details 5-54
Editing the Properties of a Neighbor 5-55
Configuring Switch Discovery 5-57
Configuring Discovery Profiles 5-57
Adding a New Discovery Profile 5-59
Viewing Recently Found Devices 5-60
Configuring SOLE Support 5-62
Defining the SOLE Configuration 5-62
Viewing SOLE Adapters 5-63
Reviewing SOLE Statistics 5-64

Chapter 6. Switch Security

Displaying the Main Security Interface 6-2
AP Intrusion Detection 6-4
Enabling and Configuring AP Detection 6-4
Adding or Editing an Allowed AP 6-6
Approved APs (Reported by APs) 6-7
Unapproved APs (Reported by APs) 6-8
Unapproved APs (Reported by MUs) 6-9
MU Intrusion Detection 6-10
Configuring MU Intrusion Detection 6-10
Viewing Filtered MUs 6-12
Configuring Wireless Filters 6-14
Editing an Existing Wireless Filter 6-15
Adding a new Wireless Filter 6-16
Associating an ACL with WLAN 6-17
ACL Configuration 6-19
ACL Overview 6-19
Router ACLs 6-20
Port ACLs 6-21
Wireless LAN ACLs 6-21
ACL Actions 6-21
Precedence Order 6-22
Configuring an ACL 6-22
Adding a New ACL 6-23
Adding a New ACL Rule 6-24
Editing an Existing Rule 6-26
Attaching an ACL L2/L3 Configuration 6-27
Adding a New ACL L2/L3 Configuration 6-28
Attaching an ACL on a WLAN Interface/Port 6-30
Adding or Editing a New ACL WLAN Configuration 6-31

Reviewing ACL Statistics 6-31
Configuring NAT Information 6-33
Defining Dynamic NAT Translations 6-33
Adding a New Dynamic NAT Configuration 6-35
Defining Static NAT Translations 6-36
Adding a New Static NAT Configuration. 6-38
Configuring NAT Interfaces 6-39
Viewing NAT Status. 6-41
Configuring IKE Settings 6-42
Defining the IKE Configuration 6-42
Setting IKE Policies 6-44
Viewing SA Statistics 6-47
Configuring IPSec VPN 6-49
Defining the IPSec Configuration. 6-51
Editing an Existing Transform Set 6-52
Adding a New Transform Set 6-54
Defining the IPSec VPN Remote Configuration 6-55
Configuring IPSEC VPN Authentication 6-57
Configuring Crypto Maps 6-59
Crypto Map Entries 6-60
Crypto Map Peers. 6-62
Crypto Map Manual SAs 6-64
Crypto Map Transform Sets. 6-66
Crypto Map Interfaces 6-67
Viewing IPSec Security Associations 6-69
Configuring the Radius Server 6-71
Radius Overview 6-71
User Database 6-72
Authentication of Terminal/Management User(s). 6-73
Access Policy 6-73
Proxy to External Radius Server. 6-73
LDAP. 6-73
Accounting 6-73
Using the Switch's Radius Server Versus an External Radius Server. 6-73
Defining the Radius Configuration. 6-74
Radius Client Configuration 6-75
Radius Proxy Server Configuration 6-76
Configuring Radius Authentication and Accounting 6-77
Configuring Radius Users. 6-79
Configuring Radius User Groups 6-82
Viewing Radius Accounting Logs. 6-85
Creating Server Certificates. 6-86
Using Trustpoints to Configure Certificates 6-86
Creating a Server / CA Root Certificate. 6-88
Configuring Trustpoint Associated Keys 6-94
Adding a New Key 6-95
Transferring Keys 6-95

Configuring Enhanced Beacons and Probes 6-96
Configuring the Beacon Table 6-96
Configuring the Probe Table 6-99
Reviewing the Beacons Found Report 6-100
Reviewing the Probes Report 6-102

Chapter 7. Switch Management

Displaying the Management Access Interface 7-2
Configuring Access Control 7-3
Configuring SNMP Access 7-5
Configuring SNMP v1/v2 Access 7-5
Editing an Existing SNMP v1/v2 Community Name 7-6
Configuring SNMP v3 Access 7-7
Editing a SNMP v3 Authentication and Privacy Password 7-9
Accessing SNMP v2/v3 Statistics 7-9
Configuring SNMP Traps 7-11
Enabling Trap Configuration 7-11
Configuring Trap Thresholds 7-13
Wireless Trap Threshold Values 7-15
Configuring SNMP Trap Receivers 7-17
Editing SNMP Trap Receivers 7-18
Adding SNMP Trap Receivers 7-19
Configuring Management Users 7-20
Configuring Local Users 7-20
Creating a New Local User 7-21
Modifying an Existing Local User 7-22
Creating a Guest Admin and Guest User 7-24
Configuring Switch Authentication 7-25
Modifying the Properties of an Existing Radius Server 7-27
Adding a New Radius Server 7-28

Chapter 8. Diagnostics

Displaying the Main Diagnostic Interface 8-2
Switch Environment 8-2
CPU Performance 8-3
Switch Memory Allocation 8-5
Switch Disk Allocation 8-6
Switch Memory Processes 8-7
Other Switch Resources 8-8
Configuring System Logging 8-9
Log Options 8-9
File Management 8-10
Viewing the Entire Contents of Individual Log Files 8-12
Transferring Log Files 8-14
Reviewing Core Snapshots 8-15
Transferring Core Snapshots 8-16

Reviewing Panic Snapshots 8-17
Viewing Panic Details. 8-18
Transferring Panic Files 8-18
Debugging the Applet. 8-19
Configuring a Ping 8-20
Modifying the Configuration of an Existing Ping Test 8-22
Adding a New Ping Test. 8-23
Viewing Ping Statistics. 8-24

1

Overview

The RFS7000 switch is a centralized management solution for wireless networking. It connects to non-legacy access ports through L2 or L3 (L2 is preferable, if the situation allows it).

Access ports function as radio antennas for data traffic management and routing. System configuration and intelligence for the wireless network resides with the switch. The switch uses access ports to bridge data to and from wireless devices. The wireless switch applies appropriate policies to data packets before forwarding them to their destination.

All data packets to and from wireless devices are processed by the switch, where appropriate policies are applied before they are decapsulated and sent to their destination.

Access port configuration is managed by the switch through a Web UI *Graphical User Interface* (GUI), SNMP or the switch *Command Line Interface* (CLI).

1.1 Hardware Overview

The RFS7000 is a rack-mountable device that manages all inbound and outbound traffic on the wireless network. It provides security, network service and system management applications.

Unlike traditional wireless infrastructure devices that reside at the edge of a network, the switch uses centralized, policy-based management to apply sets of rules or actions to all devices on the wireless network. It collects management "intelligence" from individual access ports/points and moves the collected information into the centralized switch.

Access ports (APs) are 48V Power-over-Ethernet devices connected to the switch by an Ethernet cable. An access port receives 802.11x data from MUs and forwards the data to the switch which applies the appropriate policies and routes the packets to their destinations.

Access ports do not have software or firmware upon initial receipt from the factory. When the access port is first powered on and cleared for the network, the switch initializes the access port and installs a small firmware file automatically. Installation and firmware upgrades are automatic and transparent.

1.1.1 Physical Specifications

The physical dimensions and operating parameters of the switch include:

Width	440mm (17.32 in)
Height	44.45mm (1.75 in)
Depth	390.8mm (15.38 in)
Weight	6.12 Kg (13.5 lbs)
Operating Temperature	0°C - 40°C
Operating Humidity	5% - 85% RH, non-condensing
Operating Altitude	3 km (10,000 ft.)

1.1.1.1 Power Cord Specifications

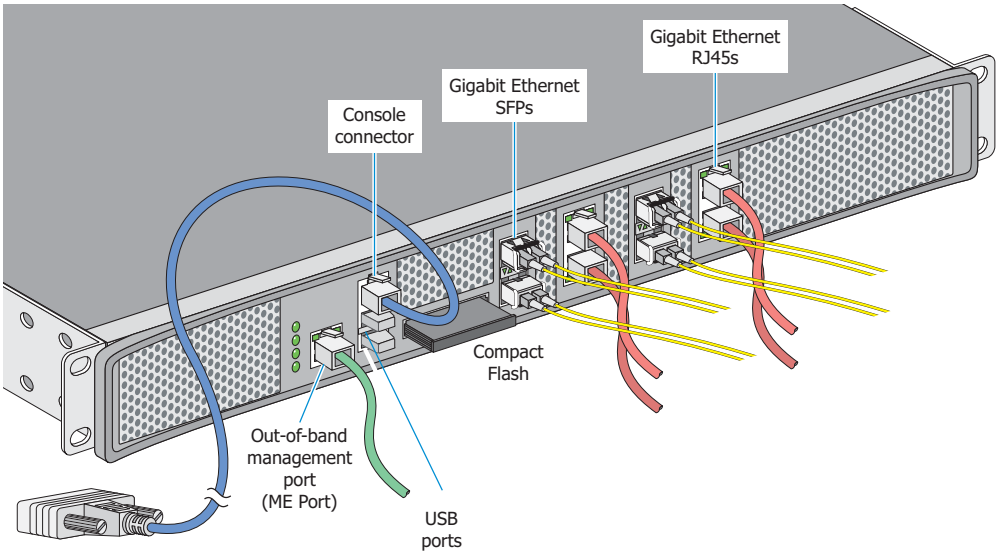
A power cord is not supplied. Use only a correctly rated power cord certified for the country of operation.

1.1.1.2 Power Protection

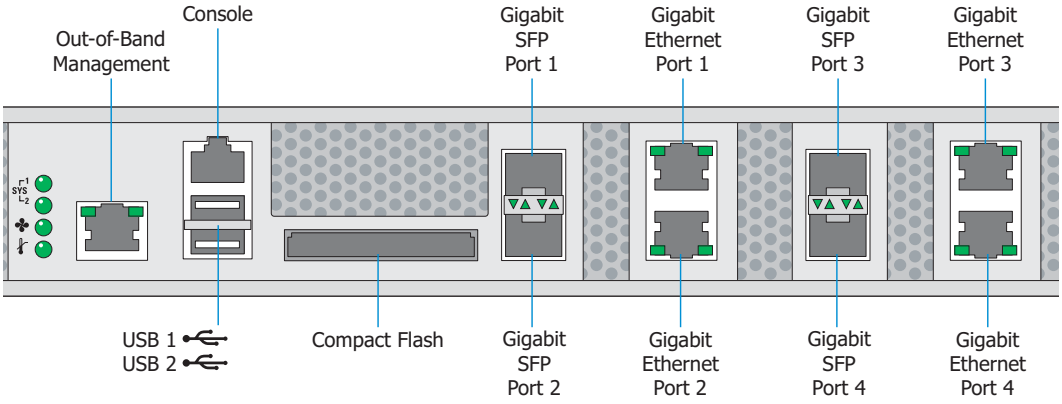
To best protect the switch from unexpected power surges or other power-related problems, ensure the system installation meets the following power protection guidelines:

- *If possible, use a dedicated circuit to protect data processing equipment*. Commercial electrical contractors are familiar with wiring for data processing equipment and can help with the load balancing of dedicated circuits.
- *Install surge protection*. Use a surge protection device between the electricity source and the switch.
- *Install an Uninterruptible Power Supply (UPS)*. A UPS provides continuous power during a power outage. Some UPS devices have integral surge protection. UPS equipment requires periodic maintenance to ensure reliability. A UPS of the proper capacity for the data processing equipment must be purchased.

1.1.1.3 Cabling Requirements



The RFS7000 has four RJ-45 Gigabit Ethernet ports, four Gigabit SFP (fiber) ports, one out-of-band management port and one console connector. The illustration below displays each of ports and the cables or devices attaching to them.

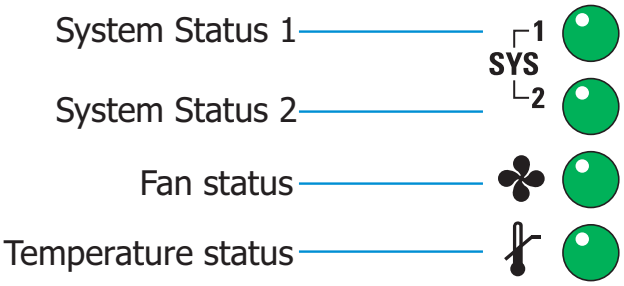


Again, a power cord is not supplied with the switch. Use only a correctly rated power cord certified for the country of operation. Initial installation instructions are described in the *RFS7000 Series Switch Installation Guide* included with the switch.

1.1.2 System Status LED Codes

The RFS7000 has four vertically-stacked LEDs on its front panel. Each of the switch's Gigabit Ethernet ports have two status LEDs. These LEDs display two colors (green & amber), and three lit states (solid, blinking, and off). The following tables describe the combinations of LED colors and states for the System Status LEDs and the Gigabit Ethernet LEDs.

1.1.2.1 System Status LEDs



Start Up / POST (Primary System or Redundant System)

System Status 1 LED	*System Status 2 LED*	*Event*
Off	Off	Power off
Green Blinking	Green Blinking	Power On Self Test (POST) running
Green Solid	Green Blinking	POST succeeded (Operating System Loading)
Green Solid	Off	POST succeeded (Normal Operation)
Amber Blinking	Off	POST Failure
Alternating Green Blinking & Amber Blinking	Alternating Green Blinking & Amber Blinking	Boot Up Error: Device has an invalid checksum

NOTE When starting the switch, the Temperature Status LED will be Solid Amber. This is normal behavior and does not indicate an error. At the completion of the start-up process, the Temperature Status LED will switch to Solid Green.

Switch Status (Primary System)

System Status 1 LED	*System Status 2 LED*	*Event*
Off	Off	Power off
Green Solid	Off	No Redundancy Feature Enabled
Green Solid	Green Solid	Redundancy Feature Enabled Actively Adopting Access Ports
Green Solid	Amber Blinking	No License to adopt Access Ports or No Country Code configured on the switch or License and Country Code configured, but no APs adopted

Switch Status (Redundant System)

System Status 1 LED	*System Status 2 LED*	*Event*
Off	Off	Power off
Green Solid	Off	No redundancy feature enabled
Green Blinking	Green Solid	Redundant system failed over and adopting ports
Green Blinking	Alternating Green Blinking & Amber Blinking	Redundant system not failed over.
Green Solid	Amber Blinking	No License to adopt Access Ports or No Country Code configured on the switch or License and Country Code configured, but no APs adopted

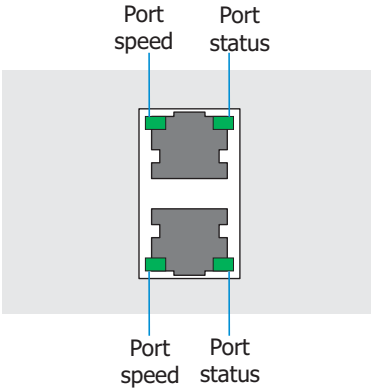
Fan LED

Fan LED	*Event*
Off	System Off / POST Start
Green Blinking	POST in process
Green Solid	All system fans in normal operation
Amber Solid	Redundant cooling failure System operational
Amber Blinking	System cooling failure *System will be held in reset until the issue is resolved*

Temperature Status LED

Temperature LED	*Event*
Off	System Off
Green Solid	Ambient inlet temperature is within specified operating limit
Amber Solid	Ambient inlet temperature is near the maximum operating temperature When starting the switch, this LED will be lit Solid Amber. This is normal behavior and does not indicate an error
Amber Blinking	Ambient inlet temperature is above the maximum specified operating temperature *System will be held in reset until the issue is resolved*

1.1.2.2 RJ-45 Gigabit Ethernet LEDs



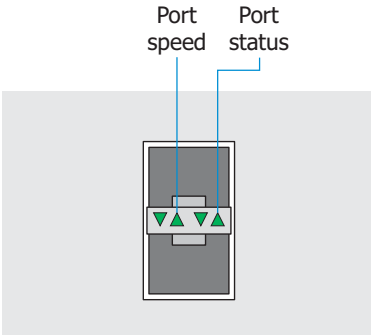
RJ-45 Port Speed LED

Port Speed LED	*Event*
Off	10 Mbps
Green Solid	100 Mbps
Green Blinking	1000 Mbps
Amber Blinking	Port fault

RJ-45 Port Status LED

Port Status LED	*Event*
Off	No link or administratively shut down
Green Solid	Link present
Green Blinking	Activity: Transmit and receive
Amber Blinking	Link fault

1.1.2.3 SFP Gigabit Ethernet LEDs



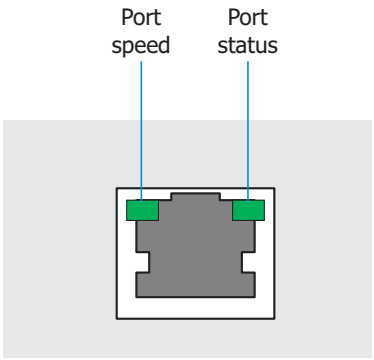
SFP Port Speed LED

Port Speed LED	*Event*
Green Blinking	1000 Mbps
Amber Blinking	Module or Tx/Rx fault loss

SFP Port Status LED

Port Status LED	*Event*
Off	No link or administratively shut down
Green Solid	Link present / Operational
Amber Blinking	Module or Tx/Rx fault loss

1.1.2.4 Out of Band Management Port LEDs



Out of Band Management Port Speed LED

Port Speed LED	*Event*
Off	10 Mbps
Green Solid	100 Mbps
Amber Blinking	Port fault

Out of Band Management Port Status LED

Port Status LED	*Event*
Off	No link
Green Solid	Link present
Green Blinking	Activity: Transmit and receive
Amber Blinking	Link fault

1.2 Software Overview

The switch includes a robust set of features. The features are listed and described in the following sections:

- *Infrastructure Features*
- *Wireless Switching*
- *Wired Switching*

- *Management Features*
- *Security Features*
- *Access Port Support*

NOTE The *Motorola RF Management Software* is a recommended utility to plan the deployment of the switch and view its configuration once operational in the field. Motorola RFMS can help optimize the positioning and configuration of a switch in respect to a WLAN's MU throughput requirements and can help detect rogue devices. For more information, refer to the Motorola Web site.

1.2.1 Infrastructure Features

The switch includes the following Infrastructure features:

- *Installation Feature*
- *Licensing Support*
- *Configuration Management*
- *Diagnostics*
- *Serviceability*
- *Tracing / Logging*
- *Process Monitor*
- *Hardware Abstraction Layer and Drivers*
- *Redundancy*
- *Secure Network Time Protocol (SNTP)*
- *Password Recovery*

1.2.1.1 Installation Feature

The upgrade/downgrade of the switch can be performed at boot time using one of the following methods:

- *Web UI*
- *DHCP*
- *CLI*
- *SNMP*
- *Patches*

1.2.1.2 Licensing Support

The following licensing information is utilized when upgrading the switch.

- The maximum numbers of AP licenses a switch can adopt is 256.
- Install/remove AP licenses in batches of 6 APs at a time.
- The Radius server and VPN capability is not a part of the licenses feature.

1.2.1.3 Configuration Management

The system supports redundant storage of configuration files to protect against corruption during a write operation and ensures (at any given time) a valid configuration file exists. If a configuration file has failed to completely execute, it is rolled back and the pre-write file is used.

Text Based Configuration

The configuration is stored in a human readable format (a set of CLI commands).

1.2.1.4 Diagnostics

The following switch diagnostics are available:

1. In-service diagnostics – In-service diagnostics provide a range of automatic health monitoring features ensuring both the system hardware and software are in working order. The in-service-diagnostics continuously monitor any available physical characteristics (as detailed below) and issues log messages when either warning or error thresholds are reached. There are three types of in-service diagnostics:
   - *Hardware* – Ethernet ports, chip failures, system temperature via the temperature sensors provided by the hardware, etc.
   - *Software* – CPU load, memory usage, etc.
   - *Environmental* – CPU and air temperature, fans speed, etc.
2. Out-of-service diagnostics – Out-of-service diagnostics are a set of intrusive tests run from the user interface. Out-of-service diagnostics cannot be run while the unit is in operation. The intrusive tests include:
   - Ethernet loopback tests
   - RAM tests, Real Time Clock tests, etc.
3. Manufacturing diagnostics – Manufacturing diagnostics are a set of diagnostics used by manufacturing to inspect the quality of the hardware.

1.2.1.5 Serviceability

A special set of service CLI commands are available to provide additional troubleshooting capabilities for service personnel (for example, check the time critical processes were started), access to Linux services, panic logs, etc. Only authorized users or service personnel are provided access to the service CLI.

A built-in packet sniffer allows service personnel to capture incoming and outgoing packets in a buffer.

The switch also maintains various statistics for RF activity, Ethernet ports etc. RF statistics include roaming stats, packet counters, octets tx/rx, signal, noise SNR, retry, and information for each MU.

1.2.1.6 Tracing / Logging

Log messages are well-defined and documented system messages with various destinations. They are numbered and referenced by ID. Each severity level group can be configured separately to go to either the serial console, telnet interface, log file or remote syslog server.

Trace messages are more free-form and are used mainly by support personnel for tracking problems. They are enabled or disabled using the switch CLI. Trace messages can go to a log file or the serial console.

Log and trace messages are in the same log file, so chronological order is preserved. Log and trace messages from different processes are similarly interleaved in the same file for the same reason.

The log message format is similar to the format used by syslog messages (RFC 3164). Log messages include message severity, source (facility), the time the message was generated and a textual message describing the situation triggering the event. For more information on using the switch logging functionality, see *Configuring System Logging on page 8-9*.

1.2.1.7 Process Monitor

The switch process monitor constantly checks to ensure processes under its control are up and running. Each monitored process sends the process monitor periodic heartbeat messages. A process that is down (due to a software crash or stuck in an endless loop) is detected when its heartbeat is not received. Such a process is terminated (if still running) and restarted (if configured) by the process monitor.

1.2.1.8 Hardware Abstraction Layer and Drivers

The *Hardware Abstraction Layer* (HAL) provides an abstraction library with an interface hiding hardware/ platform specific data. Drivers include platform specific components such as Ethernet, flash memory storage and thermal sensors.

1.2.1.9 Redundancy

Using the switch redundancy functionality, up to 12 switches can be configured in a redundancy group (and thereby provide group monitoring). In the event of a switch failure, a switch within the cluster takes control. Therefore, the switch supported network is always up and running even if a switch fails or is removed for maintenance or software upgrade. Switch redundancy provides minimal traffic disruption in the event of a switch failure or intermediate network failure.

The following redundancy features are supported:

- Up to 12 switch redundancy members supported per group. Each member is capable of tracking statistics for the entire group in addition to their own.
- Each redundancy group is capable of supporting an Active/Active configuration. Each redundancy group can support two or more primary members, each responsible for group load sharing.
- Members within the same redundancy group can be deployed across different subnets and maintain their interdependence as redundancy group members.
- Each member of the redundancy group supports AP load balancing by default.
- Members of the redundancy group support license aggregation. When a new member joins the group, the new member can leverage the access port adoption license(s) of existing members.
- Each member of the redundancy group (including the reporting switch) capable of displaying cluster performance statistics for all members in addition to their own.
- Centralized redundancy group management using the switch CLI.

For information in configuring the switch for redundancy group support, see *Configuring Switch Redundancy on page 5-35*.

1.2.1.10 Secure Network Time Protocol (SNTP)

Secure Network Time Protocol (SNTP) manages time and/or network clock synchronization within the switch managed network environment. SNTP is a client/server implementation. The switch (a SNTP client) periodically synchronizes its clock with a master clock (an NTP server). For example, the switch resets its clock to 07:04:59 upon reading a time of 07:04:59 from its designated NTP server. Time synchronization is recommended for switch network operations. The following holds true:

- The switch can be configured to provide NTP services to NTP clients.
- The switch can provide NTP support for user authentication.
- *Secure Network Time Protocol* (SNTP) clients can be configured to synchronize switch time with an external NTP server.

For information on configuring the switch to support SNTP, see *Configuring Secure NTP on page 5-24*.

1.2.1.11 Password Recovery

The switch has a provision enabling the restoration of its factory default configuration if a password is lost. In doing so, the current configuration is erased and can be restored assuming if has been exported to a secure location. For information on password recovery, see *Switch Password Recovery on page 2-3*.

1.2.2 Wireless Switching

The switch includes the following wireless switching features:

- *Physical Layer Features*
- *Proxy-ARP*
- *Hotspot / IP Redirect*
- *IDM (Identity Driven Management)*
- *Voice Prioritization*
- *Self Healing*
- *Wireless Capacity*
- *AP and MU Load Balancing*
- *Wireless Roaming*
- *Power Save Polling*
- *QoS*
- *Wireless Layer 2 Switching*
- *Automatic Channel Selection*
- *WMM-Unscheduled APSD*
- *Adaptive AP*
- *Multiple VLANs per WLAN*

1.2.2.1 Adaptive AP

An *adaptive AP* (AAP) is an AP-51XX access point that can adopt like an AP300 (L3). The management of an AAP is conducted by the switch, once the access point connects to the switch and receives its AAP configuration.

An AAP provides:

- *local 802.11 traffic termination*
- *local encryption/decryption*
- *local traffic bridging*
- *tunneling of centralized traffic to the wireless switch*

An AAP's switch connection can be secured using IP/UDP or IPSec depending on whether a secure WAN link from a remote site to the central site already exists.

The switch can be discovered using one of the following mechanisms:

- *DHCP*
- *Switch fully qualified domain name (FQDN)*
- *Static IP addresses*

The benefits of an AAP deployment include:

- *Centralized Configuration Management & Compliance* - Wireless configurations across distributed sites can be centrally managed by the wireless switch or cluster.
- *WAN Survivability* - Local WLAN services at a remote sites are unaffected in the case of a WAN outage.
- *Securely extend corporate WLAN's to stores for corporate visitors* - Small home or office deployments can utilize the feature set of a corporate WLAN from their remote location.
- *Maintain local WLAN's for in store applications* - WLANs created and supported locally can be concurrently supported with your existing infrastructure.

For an overview of AAP and how it is configured and deployed using the switch and access point, see *B.1 Adaptive AP Overview*.

1.2.2.2 Physical Layer Features

802.11a

- *DFS Radar Avoidance – Dynamic Frequency Selection* (DFS) functionality is mandatory for WLAN equipment intended to operate in the frequency bands 5150 MHz to 5350 MHz and 5470 MHz to 5725 MHz when the equipment operates in the countries of EU. The purpose of DFS is:
  - Detect interference from other systems and avoid co-channeling with those systems, most notably radar systems.
  - Provide uniform loading of the spectrum across all devices.

  This feature is enabled automatically when the country code indicates DFS is required for at least one of the frequency bands that are allowed in the country.
- *TPC – Transmit Power Control* (TPC) meets the regulatory requirement for maximum power and mitigation for each channel. The TPC functionality is enabled automatically for every AP that operates on the channel.

802.11bg

- *Dual mode b/g protection* – The ERP builds on the payload data rates of 1 and 2 Mbit/s that use DSSS modulation and builds on the payload data rates of 1, 2, 5.5, and 11 Mbit/s, that use DSSS, CCK, and optional PBCC modulations. ERP provides additional payload data rates of 6, 9, 12, 18, 24, 36, 48, and 54 Mbit/s. Of these rates, transmission and reception capability for 1, 2, 5.5, 11, 6, 12, and 24 Mbit/s data rates is mandatory.
  Two additional optional ERP-PBCC modulation modes with payload data rates of 22 and 33 Mbit/s are defined. An ERP-PBCC station may implement 22 Mbit/s alone or 22 and 33 Mbit/s. An optional modulation mode known as DSSS-OFDM is also incorporated with payload data rates of 6, 9, 12, 18, 24, 36, 48, and 54 Mbit/s.
- *Short slot protection* – The slot time is 20 µs, except an optional 9 µs slot time may be used when the BSS consists of only ERP STAs capable of supporting this option. The optional 9 µs slot time should not be used if the network has one or more non-ERP STAs associated. For IBSS, the Short Slot Time field is set to 0, corresponding to a 20 µs slot time.

1.2.2.3 Proxy-ARP

Proxy ARP is provided for MU's in PSP mode whose IP address is known. The WLAN generates an ARP reply on behalf of a MU, if the MU's IP address is known. The ARP reply contains the MAC address of the MU (not the MAC address of switch). Thus, the MU is not woken to send ARP replies (increasing battery life and conserving wireless bandwidth).

If an MU goes into PSP mode without transmitting at least one packet, its Proxy ARP will not work for such an MU.

1.2.2.4 Hotspot / IP Redirect

A hotspot is a Web page users are forced to visit before they are granted access to the Internet. With the advent of Wi-Fi enabled client devices (such as laptops and PDAs) commercial hotspots are common and can be found at many airports, hotels and coffee shops.The Hotspot / IP Redirect feature allows the switch to function as a single on-site switch supporting WLAN hotspots. The Hotspot feature re-directs user traffic (for a hotspot enabled WLAN) to a Web page that requires them to authenticate before granting access to the WLAN. The IP-Redirection requires no special software on the client but its does require the client be set to receive its IP configuration through DHCP. The following is a typical sequence for hotspot access:

1. A visitor with a laptop requires hotspot access at a site.
2. A user ID/ Password and the hotspot ESSID are issued by the site receptionist or IT staff.
3. The user connects their laptop to this ESSID
4. The laptop receives its IP configuration via DHCP. The DHCP service can be provided by an external DHCP server or provided by the internal DHCP server located on the switch.
5. The user opens a Web browser and connects to their home page.
6. The switch re-directs them to the hotspot Web page for authentication.
7. The user enters their User ID/ Password.
8. A Radius server authenticates the user.
9. Upon successful authentication, the user is directed to a Welcome Page that lists among other things an Acceptable Use Policy, connection time remaining and an I Agree button.
10. The user accepts by clicking the I Agree button and is granted access to the Internet. (or other network services).

To redirect user traffic from a default home page to a login page, the switch uses destination network address translation (destination NAT is similar to the source NAT/ PAT but the destination IP address and port get modified instead of the source as in traditional NAT). More specifically, when the switch receives an HTTP Web page request from the user (when the client first launches its browser after connecting to the WLAN), a protocol stack on the switch intercepts the request and sends back an HTTP response after modifying the network and port address in the packet. Therefore, acting like a proxy between the user and the Web site they are trying to access.

To setup a hotspot, create a WLAN ESSID and select Hotspot authentication from the Authentication menu. This is simply another way to authenticate a WLAN user, as it would be impractical to authenticate visitors using 802.1x authentication. For information on configuring hotspot support for the WLAN, see *Configuring Hotspots on page 4-35*.

1.2.2.5 IDM (Identity Driven Management)

Radius authentication is performed for all protocols using a Radius-based authentication scheme such as EAP. Identity driven management is provided using a Radius client. The following IDMs are supported:

- *User based SSID authentication* — Denies authentication to MUs if associated to a SSID configured differently in their Radius server.
- *User based VLAN assignment* — Allows the switch to extract VLAN information from the Radius server.
- *User based QoS* — Enables QoS for the MU based on settings in Radius Server.

1.2.2.6 Voice Prioritization

The switch has the capability of having its QoS policy configured to prioritize network traffic requirements for associated MUs. Use QoS to enable voice prioritization for devices using voice as its transmission priority.

Voice prioritization allows you to assign priority to voice traffic over data traffic, and (if necessary) assign legacy voice supported devices (non WMM supported voice devices) additional priority.

Currently voice support implies the following:

- *Spectralink voice prioritization* - Spectralink sends packets that allow the switch to identify these MU's as voice MU's. Thereafter, any UDP packet sent by these MU's is prioritized ahead of data.
- *Strict priority* - The prioritization is strict.
- *Multicast prioritization* - Multicast frames that match a configured multicast mask bypass the PSP queue. This features permits intercom mode operation without delay (even in the presence of PSP MU's).

For information on configuring voice prioritization for a target WLAN, see *Configuring WMM on page 4-61*.

1.2.2.7 Self Healing

Self healing is the ability to dynamically adjust the RF network by modifying transmit power and/or supported rates, based on an AP failure.

In a typical RF network deployment, APs are configured for transmit power below their maximum level. This allows Tx Power to be increased when there is a need to increase coverage whenever an AP fails.

When an AP fails, the Tx power/supported rates of APs neighboring the failed AP is adjusted. The Tx power is increased and/or supported rates are decreased. When the failed AP becomes operational again, the Neighbor AP's Tx power/supported rates are brought back to the levels before the self healing operation began.

The switch detects an AP failure when:

- *An AP stops sending heartbeats.*
- *AP beacons are no longer being sent.*

Configure 0 (Zero) or more APs to act as either:

- *Detector APs* — Detector APs scan all channels and send beacons to the switch (which uses the information for self-healing).
- *Neighbor APs* — When an AP fails, neighbor APs assist in self healing.
- *Self Healing Actions* — When an AP fails, actions are taken on the neighbor APs to conduct self-healing.

Detector APs

Configure an AP in either – Data mode (the regular mode) or Detector mode.

In Detector mode, the AP scans all channels at a configurable rate and forwards received beacons the switch. The switch uses the received information to establish a *receive signal strength baseline* over a period of time and initiates self-healing procedures (if necessary).

Neighbor Configuration

Neighbor detect is a mechanism allowing an AP to detect its neighbors and their signal strength. This enables you to verify your installation and configure it for self-healing when an AP fails.

Self Healing Actions

This mechanism allows you to assign a self healing action to an AP's neighbors, on a per-AP basis. If AP1 detects AP2 and AP3 as its neighbors, you can assign failure actions to AP2 and AP3 if AP1 were to fail.

Assign up to four self healing actions:

- *No action*
- *Decrease supported rates*
- *Increase Tx power*
- *Both 2 and 3.*

Specify the Detector AP (AP2 or AP3) to stop detecting and adopt the RF settings of a failed AP.

For information on configuring self healing, see *Configuring Self Healing on page 5-53*.

1.2.2.8 Wireless Capacity

Wireless capacity specifies the maximum number of MUs, access ports and wireless networks usable by a given switch. Wireless capacity is largely independent of performance. Aggregate switch performance is divided among the switch clients (MUs and access ports) to define the performance experienced by a given user. Each switch platform is targeted at specific market segments, so the capacity of each platform is chosen appropriately. Wireless switch capacity is measured by:

- *Maximum number of WLANs per switch*
- *Maximum number of access ports per switch*
- *Maximum number of MUs per switch*
- *Maximum number of MUs per access port.*

Up to 256 access ports are supported by the switch. The actual number of access ports adoptable by a switch is defined on a per platform basis and will typically be lower than 256.

1.2.2.9 AP and MU Load Balancing

Fine tune a network to evenly distribute the data and/or processing across available resources. The following topics define load balancing:

- *MU Balancing Across Multiple APs*
- *AP Balancing Across Multiple Switches*

MU Balancing Across Multiple APs

As per the 802.11 standard, AP and MU association is a process conducted independently of the switch. 802.11 provides message elements used by the MU firmware to influence the roaming decision. The switch implements the following MU load balancing techniques:

- *802.11e admission control* — 1 byte: channel utilization % and 1 byte: MU count is sent in QBSS Load Element in beacons to MU.
- *Load balancing element (proprietary)* — 2 byte: Kbps, 2 byte: Kbps and 2 byte: MU Count are sent in beacon to MU.

AP Balancing Across Multiple Switches

At adoption, the AP solicits and receives multiple adoption responses from switches on the network. These adoption responses contain preference and loading information the AP uses to select the optimum switch to be adopted by. Use this mechanism to define which APs are adopted by which switches. By default, the adoption algorithm generally distributes AP adoption evenly among the switches available.

NOTE Each switch can support a maximum of 256 access ports. However, port adoption per switch is determined by the number of licenses acquired.

1.2.2.10 Wireless Roaming

The following forms of wireless roaming are supported:

- *L3 Roaming*
- *Fast Roaming*
- *Interswitch Layer 2 Roaming*
- *International Roaming*
- *MU Move Command*
- *Virtual AP*

L3 Roaming

L3 Roaming works across a set of switches configured to exchange mobility related information for all MUs associated with "mobility-enabled" WLANs. The switches have to be explicitly configured as mobility peers. A full mesh of peering sessions is required for L3 Roaming to work correctly. Peering sessions use TCP to carry mobility update messages that include the MAC address, IP address, home switch, current switch and home-switch VLAN ID of the all MUs. Data packets to and from MUs are tunneled between mobility peers using GRE (*Generic Routing Encapsulation*) tunnels. TCP provides the following advantages:

- TCP re-transmits lost messages thereby providing reliable connectivity
- TCP ensures ordered message delivery using sequenced numbers.
- TCP has a built-in “keep-alive” mechanism which helps detect loss of connectivity to the peer or peer failure.

Fast Roaming

Using 802.11i can speed up the roaming process from one AP to another. Instead of doing a complete 802.1x authentication each time a MU roams between APs, 802.11i allows a MU to re-use previous PMK authentication and perform only a four-way handshake. This process greatly speeds up the roaming process. In addition to reusing PMKs on previously visited APs, Opportunistic Key Caching allows multiple APs to share

PMKs among themselves. This allows an MU to roam to an AP that it has not previously visited and reuse a PMK from another AP to skip the 802.1x authentication.

Interswitch Layer 2 Roaming

An associated MU (connected to a particular wireless switch) can roam to another access port connected to a different wireless switch. Both switches must be on the same L2 domain. Authentication information is not shared between switches, nor is buffered packets on one switch transferred to the other switch. Pre-authentication between the switch and MU allows faster roaming.

International Roaming

The switch supports international roaming per the 802.11d specification.

MU Move Command

As a value added proprietary feature between infrastructure products and MUs, a *move* command has been introduced. This command permits an MU to roam between ports connected to the same switch without the need to perform the full association and authentication defined by the 802.11 standard. The *move* command is a simple packet up/packet back exchange with the access port. Verification of this feature is dependent on its implementation in one or more MUs.

Virtual AP

The switch supports multiple *Basic Service Set Identifiers* (BSSIDs). An access port capable of supporting multiple BSSID's generates multiple beacons, one per BSSID. Hence, an AP that supports 4 BSSID's can send 4 beacons. The basic requirement for supporting multiple BSSID's is multiple MAC addresses, since each BSSID is defined by its MAC address.

When multiple BSSID's are enabled, you cannot tell by snooping the air whether any pair of beacons is sent out by the same physical AP or different physical AP. Hence the term "virtual AP's"- each virtual AP behaves exactly like a single-BSSID AP.

Each BSSID supports 1 *Extended Service Set Identifier* (ESSID). Sixteen ESSIDs per switch are supported.

1.2.2.11 Power Save Polling

An MU uses *Power Save Polling* (PSP) to reduce power consumption. When an MU is in PSP mode, the switch buffers its packets and delivers them using the DTIM interval. The PSP-Poll packet polls the AP for buffered packets. The PSP null data frame is used by the MU to signal the current PSP state to the AP.

1.2.2.12 QoS

QoS provides a data traffic prioritization scheme. A QoS scheme is useful to avoid congestion from excessive traffic or different data rates and link speeds.

If there is enough bandwidth for all users and applications (unlikely because excessive bandwidth comes at a very high cost), applying QoS has very little value. QoS provides policy enforcement for mission-critical applications and/or users that have critical bandwidth requirements when the switch's total bandwidth is shared by different users and applications.

The objective of QoS is to ensure each WLAN configured on the switch receives a fair share of the overall bandwidth, either equally or as per the proportion configured. Packets directed towards MUs are classified into categories such as Management, Voice and Data. Packets within each category are processed based on the weights defined for each WLAN.

The switch supports the following QoS types:

802.11e QoS

802.11e enables real-time audio and video streams to be assigned a higher priority over regular data. The switch supports the following 802.11e features:

- *Basic WMM*
- *WMM Linked to 802.1p Priorities*
- *WMM Linked to DSCP Priorities*
- *Fully Configurable WMM*
- *Admission Control*
- *Unscheduled-APSD*
- *TSPEC Negotiation*
- *Block ACKQBSS Beacon Element*

802.1p support

802.1p is a standard for providing QoS in 802-based networks. 802.1p uses three bits to allow switches to re-order packets based on priority level. 802.1p uses the *Generic Attributes Registration Protocol* (GARP) and the *GARP VLAN Registration Protocol* (GVRP). GARP allows MUs to request membership within a multicast domain, and GVRP lets them register to a VLAN.

Voice QoS

When switch resources are shared between a *Voice over IP* (VoIP) conversation and a file transfer, bandwidth is normally exploited by the file transfer, thus reducing the quality of the conversation or even causing it to disconnect. With QoS, the VoIP conversation (a real-time session), receives priority, maintaining a high level of voice quality. Voice QoS ensures:

- *Strict Priority*
- *Spectralink Prioritization*
- *VOIP Prioritization (IP ToS Field)*
- *Multicast Prioritization*

Data QoS

The switch supports the following data QoS techniques:

- *Egress Prioritization by WLAN*
- *Egress Prioritization by ACL*

DSCP to AC Mapping

The switch provides for arbitrary mapping between *Differentiated Services Code Point* (DSCP) values and WMM Access Categories. This mapping can be set manually.

1.2.2.13 Wireless Layer 2 Switching

The switch supports the following layer 2 wireless switching techniques:

- *WLAN to VLAN*
- *MU User to VLAN*
- *WLAN to GRE*

1.2.2.14 Automatic Channel Selection

Automatic channel selection works as follows:

1. When a new AP is adopted, it scans each channel. However, the switch does not forward traffic at this time.
2. The switch then selects the least crowded channel based on the noise and traffic detected on each channel.
3. The algorithm used is a simplified maximum entropy algorithm for each radio, where the signal strength from adjoining AP's/MU's associated to adjoining AP's is minimized.
4. The algorithm ensures adjoining AP's are as far away from each other as possible in terms of channel assignment.

NOTE Individual radios can be configured to perform automatic channel selection.

1.2.2.15 WMM-Unscheduled APSD

This feature is also known as WMM Power Save or WMM-UPSD (*Unscheduled Power Save Delivery*). WMM-UPSD defines an unscheduled service period, which are contiguous periods of time during which the switch is expected to be awake. If the switch establishes a downlink flow and specifies UPSD power management, then it requests and the AP delivers buffered frames associated with that flow during an unscheduled service period. The switch initiates an unscheduled service period by transmitting a trigger frame, where a trigger frame is defined as a data frame (e.g. an uplink voice frame) associated with an uplink flow having UPSD enabled. After the AP acknowledges the trigger frame, it transmits the frames in its UPSD power save buffer addressed to the triggering switch.

UPSD is well suited to support bi-directional frame exchanges between a voice STA and its AP.

1.2.2.16 Multiple VLANs per WLAN

The switch permits the mapping of a WLAN to more than one VLANs. When a MU associates with a WLAN, the MU is assigned a VLAN by means of a load balance distribution. The switch supports 32 VLANs per WLAN. The VLAN is picked from a pool assigned to the WLAN. The switch tracks the number of MUs per VLAN, and assigns the least used/loaded VLAN to the MU. This number is tracked on a per-WLAN basis.

A broadcast key, unique to the VLAN, encrypts all packets coming from the VLAN. This ensures broadcast integrity across wired and wireless networks. If two or more MUs are on two different VLANs, they both are able to hear the broadcast packet, but only one can decrypt it. The switch provides each MU a unique VLAN broadcast key as part of the WPA2 handshake or group key update message of a WPA handshake.

Limiting Users Per VLAN

Multiple VLANs mapped to a WLAN cannot map back to the same IP address pool size. Assign a user limit to each VLAN to allow the mapping of different pool sizes.

Specify an integer value for a VLAN user limit. This specifies the maximum number of MUs associated with a VLAN for a particular WLAN. When the number of MUs reaches the maximum limit, no more MUs are assigned to that VLAN.

Packet Flows

The following types of packet flows are supported when the switch is configured for multiple VLAN per WLAN support:

- *Unicast From Mobile Unit* – Frames are decrypted, converted from 802.11 to 802.3 and switched to the wired side of the VLAN dynamically assigned to the mobile device. If the destination is another mobile device on the wireless side, the frame is encrypted and switched over the air.
- *Unicast To Mobile Unit* – The frame is checked to ensure that in addition to the destination MAC address matching that of the mobile device, the VLAN is same as that assigned to the mobile device. It is then converted to an 802.11 frame, encrypted, and sent out over the air.
- *Multicast/Broadcast From Mobile Unit* – Treated as a unicast frame from the MU, with the exception it is encrypted with the per-VLAN broadcast key and transmitted over the air.
- *Multicast/Broadcast from Wired Side* – If the frame comes from a VLAN mapped to the WLAN, it's encrypted using a per-VLAN broadcast key and transmitted over the air. Only MUs on that VLAN have a broadcast key that can decrypt this frame. Other MUs receive it, but discard it.

  In general, when there are multiple VLANs mapped to the same WLAN, the broadcast buffer queue size scales linearly to accommodate the increase in potential more broadcast packet stream.

Roaming within the Switch

When a MU is assigned to a VLAN, the switch registers the VLAN assignment in its credential cache. If the MU roams it is assigned back to its previously assigned VLAN. The cache is flushed upon MU inactivity or if the MU associates over a different WLAN on the same switch.

Roaming Across a Cluster

MUs roam amongst member switches within a cluster. The switch must ensure a VLAN remains unchanged as MU roams. This is accomplished by passing MU VLAN information across the cluster using the interface used by a hotspot. It passes the username/password across the credential caches of the switches. This ensures a VLAN MU association is maintained even while the MU roams amongst cluster members.

Roaming Across a L3 Mobility Domain

When an MU roams amongst switches in different L3 mobility domains, L3 ensures traffic is tunneled back to the correct VLAN on the home switch.

Interaction with Radius Assigned VLANs

Multiple VLANs per WLAN can co-exist with VLANs assigned by a Radius server. Upon association, the MU is assigned to a VLAN from a pool of available VLANs. When the Radius server assigns the user another VLAN, MU traffic is forwarded to that VLAN.

When 802.1x is used, traffic from the MU is dropped until authentication is completed. None of the MU data MU is switched onto the temporarily VLAN. A Radius assigned VLAN overrides the statically assigned VLAN.

If the Radius assigned VLAN is among the VLANs assigned to a WLAN, it is available for VLAN assignment in the future. If the Radius assigned VLAN is not one of the VLANs assigned to a WLAN, it is not available for VLAN assignment in the future. To configure Multiple VLANs for a single WLAN, see *Assigning Multiple VLANs per WLAN on page 4-31*.

1.2.3 Wired Switching

The switch includes the following wired switching features:

- *DHCP Servers*
- *DDNS*
- *VLAN Enhancements*
- *Interface Management*

1.2.3.1 DHCP Servers

Dynamic Host Configuration Protocol (DHCP) allows hosts on an IP network to request and be assigned IP addresses, and discover information about the network to which they are attached. Configure address pools for each subnet. When a DHCP client requests an IP address, the DHCP server assigns an IP address from the address pool configured for that subnet.

When a DHCP server allocates an address for a DHCP client, the client is assigned a lease. The lease expires after an pre-determined interval. Before a lease expires, clients (to which leases are assigned) are expected to renew the lease to continue to use the addresses. Once the lease expires, the client is no longer permitted to use the leased IP address. For information on defining the switch DHCP configuration, see *Configuring the Switch DHCP Server on page 5-4*.

1.2.3.2 DDNS

Dynamic DNS (DDNS) is a method of keeping a domain name linked to a changing IP address. Typically, when a user connects to a network, the user's ISP assigns it an unused IP address from a pool of IP addresses. This address is only valid for a short period. Dynamically assigning IP addresses increases the pool of assignable IP addresses. DNS maintains a database to map a given name to an IP address used for communication on the Internet. The dynamic assignment of IP addresses makes it necessary to update the DNS database to reflect the current IP address for a given name. Dynamic DNS updates the DNS database to reflect the correct mapping of a given name to an IP address.

1.2.3.3 VLAN Enhancements

The switch has incorporated the following VLAN enhancements:

- Physical port (L2) is now operated in Trunk Mode or Access Mode.
- A VLAN now allows an AP to receive and send only untagged packets. All tagged packets received by the AP are discarded. The untagged traffic received is internally placed in an “access vlan”.
- A trunk port can now receive, both tagged and untagged packets. Only one native VLAN per trunk port is supported. All untagged traffic received on is placed into a “native vlan”.
- You can now configure a set of allowed VLANs on a trunk port. Packets received on this port belonging to other VLANs are discarded.

1.2.3.4 Interface Management

The switch permits a physical interface to Auto Negotiate, Full Duplex or Half Duplex. The switch also allows:

- Manual bandwidth configuration of a physical interface to 10/100/1000Mbps. This is only permitted if duplex is not set to Auto Negotiate.
- Manual configuration of administrative shutdown of a physical interface.

1.2.4 Management Features

The switch includes the following management features:

- A secure browser-based management console
- A *Command Line Interface* (CLI) accessible via the serial port or a *Secure Shell* (SSH) application
- The CLI Service mode enables the capture of system status information that can be sent to Customer Support personnel for use in problem resolution
- Support for *Simple Network Management Protocol* (SNMP) version 3 as well as SNMP version 2
- The TFTP upload and download of access port firmware and configuration files
- The graphing of wireless statistics
- A dashboard summary of system state in the Web UI
- Multi switch management via MSP application
- Heat map support for RF deployment
- Secure guest access
- Switch discovery enabling users to discover each switch on the specified network.

1.2.5 Security Features

Switch security can be classified into wireless security and wired security

The switch includes the following wireless security features:

- *Encryption and Authentication*
- *MU Authentication*
- *Secure Beacon*
- *MU to MU Allow*
- *MU to MU Disallow*
- *Switch - to - Wired*
- *802.1x Authentication*
- *WIPS*
- *Rogue AP Detection*

The switch includes the following wired security features:

- *ACLs*
- *Local Radius Server*
- *IPSec VPN*
- *NAT*
- *Firewall*

- *Certificate Management*

1.2.5.1 Encryption and Authentication

WEP

Wired Equivalent Privacy (WEP) is an encryption scheme used to secure wireless networks. WEP was intended to provide comparable confidentiality to a traditional wired network, hence the name. WEP had many serious weaknesses and hence was superseded by *Wi-Fi Protected Access* (WPA). Regardless, WEP still provides a level of security that can deter casual snooping. For information on configuring WEP for a target WLAN, see *Configuring WEP 64 on page 4-50* or *Configuring WEP 128 / KeyGuard on page 4-51*.

WEP uses passwords entered manually at both ends (Pre Shared Keys). Using the RC4 encryption algorithm, WEP originally specified a 40-bit key, but was later boosted to 104 bits. Combined with a 24-bit initialization vector, WEP is often touted as having a 128-bit key.

WPA

WPA is designed for use with an 802.1X authentication server, which distributes different keys to each user. However, it can also be used in a less secure *pre-shared key* (PSK) mode, where every user is given the same passphrase.

WPA uses *Temporal Key Integrity Protocol* (TKIP), which dynamically changes keys as the system is used. When combined with the much larger Initialization Vector, it defeats well-known key recovery attacks on WEP. For information on configuring WPA for a WLAN, see *Configuring WPA/WPA2 using TKIP and CCMP on page 4-52*.

WPA2

WPA2 uses a sophisticated key hierarchy that generates new encryption keys each time a MU associates with an access point. Protocols including 802.1X, EAP and Radius are used for strong authentication. WPA2 also supports the TKIP and AES-CCMP encryption protocols. For information on configuring WPA2 for a target WLAN, see *Configuring WPA/WPA2 using TKIP and CCMP on page 4-52*.

Keyguard-WEP

KeyGuard is a proprietary dynamic WEP solution. Motorola (upon hearing of the vulnerabilities of WEP) developed a non standard method of rotating keys to prevent compromises. Basically, KeyGuard is TKIP without the message integrity check MIC. KeyGuard is proprietary to Motorola MUs only. For information on configuring KeyGuard for a target WLAN, see *Configuring WEP 128 / KeyGuard on page 4-51*.

1.2.5.2 MU Authentication

The switch uses the following 802.11 authentication schemes for MU association:

- *Kerberos*
- *802.1x EAP*
- *MAC ACL*

Refer to *Editing the WLAN Configuration on page 4-27* to WLAN MU authentication.

Kerberos

Kerberos allows for mutual authentication and end-to-end encryption. All traffic is encrypted and security keys are generated on a per-client basis. Keys are never shared or reused, and are automatically distributed in a secure manner. For information on configuring Kerberos for a WLAN, see *Configuring Kerboros on page 4-34*.

802.1x EAP

802.1x EAP is the most secure authentication mechanism for wireless networks and includes EAP-TLS, EAP-TTLS and PEAP. The switch is a proxy for Radius packets. An MU does a full 802.11 authentication and association and begins transferring data frames. The switch realizes the MU needs to authenticate with a Radius server and denies any traffic not Radius related. Once Radius completes its authentication process, the MU is allowed to send other data traffic. Use either an onboard Radius server or internal Radius Server for authentication purposes. For information on configuring EAP for a target WLAN, see *Configuring 802.1x EAP on page 4-33*.

MAC ACL

The MAC ACL feature is basically a dynamic MAC ACL where MUs are allowed/denied access to the network based on their configuration on the Radius server. The switch allows 802.11 authentication and association, then checks with the Radius server to see if the MAC address is allowed on the network. The Radius packet uses the MAC address of the MU as both the username and password (this configuration is also expected on the Radius server). MAC-Auth supports all encryption types, and (in case of 802.11i) the handshake is allowed to be completed before the Radius lookup begins. For information on configuring MAC ACL for a target WLAN, see *Configuring MAC Authentication on page 4-43*.

1.2.5.3 Secure Beacon

All the devices in a wireless network use *Service Set Identifiers* (SSIDs) to communicate. An SSID is a text string up to 32 bytes long. An AP in the network announces its status by using beacons. To avoid others from accessing the network, the most basic security measure adopted is to change the default SSID to one not easily recognizable, and disable the broadcast of the SSID.

The SSID is a code attached to all packets on a wireless network to identify each packet as part of that network. All wireless devices attempting to communicate with each other must share the same SSID. Apart from identifying each packet, the SSID also serves to uniquely identify a group of wireless network devices used in a given service set.

1.2.5.4 MU to MU Allow

MU to MU allow enables frames from one MU (where the destination MAC is that of another MU) to be switched to the second MU. This feature can be disabled to restrict MUs from passing network credentials to one another.

1.2.5.5 MU to MU Disallow

Use MU to MU Disalllow to restrict MU to MU communication within a WLAN. The default is ‘no’, which allows MUs to exchange packets with other MUs. It does not prevent MUs on other WLANs from sending packets to this WLAN. You would have to enable MU to MU Disallow on the other WLAN.

1.2.5.6 Switch - to - Wired

MU frames are switched out to the wired network (out of the switch). Another upstream device decides whether the frame should be sent back to the second MU, and if so, it sends the frame back to the switch, and it is switched out just like any other frame on the wire. This allows a drop/allow decision to be made by a device other than the wireless switch.

1.2.5.7 802.1x Authentication

802.1x Authentication cannot be disabled (its always enabled). A factory delivered out-of-the-box AP300 supports 802.1x authentication using a default username and password. EAP-MD5 is used for 802.1x.

When you initially switch packets on an out-of-the-box AP300 port, it immediately attempts to authenticate using 802.1x. Since 802.1x supports *supplicant initiated* authentication, the AP300 attempts to initiate the authentication process.

On reset (all resets including power-up), an AP300 sends an EAPOL start message every time it sends a Hello message (periodically every 1 second). The *EAPOL start* is the *supplicant initiated* attempt to become authenticated.

If an appropriate response is received in response to the *EAPOL start* message, the AP300 attempts to proceed with the authentication process to completion. Upon successful authentication, the AP300 transmits the Hello message and the download proceeds the way as it does today.

If no response is received from the *EAPOL start* message, or if the authentication attempt is not successful, the AP300 continues to transmit *Hello* messages followed by *LoadMe* messages. If a parent reply is received in response to the *Hello message,* then downloading continue normally - without authentication. In this case, you need not enable or disable the port authentication.

802.1x authentication is conducted:

- At power up
- At an AP300 operator initiated reset (such as pulling Ethernet cable)
- When the switch administrator initiates a reset of the AP300.
- When re-authentication is initiated by the Authenticator (say the switch in between)

Change Username/Password after AP Adoption

Once the AP300 is adopted using 802.1x authentication (say default username/password) OR using a non-secure access method (hub or switch without 802.1x enabled), use the CLI/SNMP/UI to reconfigure the username/password combination.

Reset Username/Password to Factory Defaults

To restore the AP300 username/password to factory defaults, adopt the AP300 using a non-secure access method (a hub or switch without 802.1x enabled), then reconfigure the username/password combination.

The access port does not make use of any parameters (such as MAC based authentication, VLAN based etc.) configured on Radius Server.

1.2.5.8 WIPS

The Motorola *Wireless Intrusion Protection System* (WIPS) monitors for the presence of unauthorized rogue devices. Unauthorized attempts to access the WLAN is generally accompanied by anomalous behavior as intruding MUs try to find network vulnerabilities. Basic forms of this behavior can be monitored and reported without needing a dedicated WIPS. When the parameters exceed a configurable threshold, the switch generates an SNMP trap and reports the result via the management interfaces. Basic WIPS functionality does not require monitoring APs and does not perform off-channel scanning.

NOTE When converting an AP300 to an Intrusion Detection Sensor, the conversion requires approximately 60 seconds.

1.2.5.9 Rogue AP Detection

The switch supports the following rogue AP detection mechanisms:

- *Motorola RFMS Support*
- *RF scan by Access Port on all channels*
- *SNMP Trap on discovery*
- *Authorized AP Lists*
- *Rogue AP Report*
- *Motorola RFMS Support*

NOTE The *Motorola RF Management Software* is recommended to plan the deployment of the switch. Motorola RFMS can help optimize the positioning and configuration of a switch in respect to a WLAN's MU throughput requirements and can help detect rogue devices. For more information, refer to the Motorola Web site.

RF scan by access port (on one channel) requires an access port to assist in Rogue AP detection. It functions as follows:

- The switch sends a new configuration message to the adopted AP informing it to detect Rogue APs.
- The access port listens for beacons on its present channel.
- It passes the beacons to the switch as it receives them without any modification.
- The switch processes these beacon messages to generate the list of APs

The process of detecting a Rogue AP is non-disruptive and none of the MU are disassociated during this process. The access port will only scan on its present channel. An AP300 provides this support.

By choosing this option for detection, all capable access ports are polled for getting the information. You can configure how frequently this is performed.

RF scan by Access Port on all channels

This process uses Auto Channel Select (called Detector AP assist) to scan for Rogue APs on all available channels. It functions as follows:

- The switch sends a configuration message (with the ACS bit set and channel dwell time) to the access port.
- An access port starts scanning each channel and passes the beacons it hears on each channel to the switch.
- An access port resets itself after scanning all channels.
- An switch then processes this information

The process of detecting a Rogue AP is disruptive, as connected MUs loose association. MUs need to reconnect once the access port resets.

SNMP Trap on discovery

An SNMP trap is sent for each detected and Rogue AP. Rogue APs are only detected, and notification is provided via a SNMP trap.

NOTE Wired side scanning for Rogue APs using WNMP is not supported. Similarly, Radius lookup for approved AP is not provided.

Authorized AP Lists

Configure a list of authorized access ports based on their MAC addresses. The switch evaluates the APs against the configured authorized list after obtaining Rogue AP information from one of the 2 mechanisms as mentioned in *Rogue AP Detection on page 1-26*.

Rogue AP Report

After determining which are authorized APs and which are Rogue, the switch prepares a report.

Motorola RFMS Support

With this most recent switch firmware release, the switch can provide rogue device detection data to the Motorola RF Management software application (or Motorola RFMS). Motorola RFMS uses this data to refine the position and display the rogue on a site map representative of the physical dimensions of the actual radio coverage area of the switch. This is of great assistance in the quick identification and removal of unauthorized devices.

1.2.5.10 ACLs

ACLs control access to the network through a set of rules. Each rule specifies an action taken when a packet matches the given set of rules. If the action is deny, the packet is dropped, if the action is permit, the packet is allowed, if the action is to mark, the packet is tagged for priority. The switch supports the following types of ACLs:

- *IP Standard ACLs*
- *IP Extended ACLs*
- *MAC Extended ACLs*
- *Wireless LAN ACLs*

ACLs are identified by either a number or a name (the exception being MAC extended ACLs which take only name as their identifier). Numbers are predefined for IP Standard and Extended ACLs, whereas a name can be any valid alphanumeric string not exceeding 64 characters. With numbered ACLs, the rule parameters have to be specified on the same command line along with the ACL identifier. For named ACLs, rules are configured within a separate CLI context. For information on creating an ACL, see *ACL Configuration on page 6-19*.

1.2.5.11 Local Radius Server

Radius is a common authentication protocol utilized by the 802.1x wireless security standard. Radius improves the WEP encryption key standard, in conjunction with other security methods such as EAP-PEAP. The switch has one onboard Radius server. For information on configuring the switch's resident Radius Server, see *Configuring the Radius Server on page 6-71*.

1.2.5.12 IPSec VPN

IP Sec is a security protocol providing authentication and encryption over the Internet. Unlike SSL (which provides services at layer 4 and secures two applications), IPsec works at layer 3 and secures everything in the network. Also unlike SSL (which is typically built into the Web browser), IPsec requires a client installation. IPsec can access both Web and non-Web applications, whereas SSL requires workarounds for non-Web access such as file sharing and backup.

A VPN is used to provide secure access between two subnets separated by an unsecured network. There are two types of VPNs:

- *Site-Site VPN* — For example, a company branching office traffic to another branch office traffic with an unsecured link between the two locations.
- *Remote VPN* — Provides remote user ability to access company resources from outside the company premises.

The switch supports:

- *IPSec termination for site to site*
- *IPSec termination for remote access*
- *IPSec traversal of firewall filtering*
- *IPSec traversal of NAT*
- *IPSec/L2TP (client to switch)*

1.2.5.13 NAT

NAT (*Network Address Translation*) is supported for non-IPSec packets routed by the switch. The following types of NAT are supported:

- *Port NAT* – Port NAT (also known as NAPT) entails multiple local addresses are mapped to single global address and a dynamic port number. The user is not required to configure any NAT IP address. Instead, an IP address for the switch's public interface is used to NAT packets going out from private network and vice versa for packets entering private network.
- *Static NAT* – Static NAT is similar to Port NAT with the only difference that it allows the user to configure a source NAT IP address and/or destination NAT IP address to which all the packets will be NATted to. The source NAT IP address is used when hosts on a private network are trying to access a host on a public network. Destination NAT IP address can be used for public hosts to talk to a host on the private network.

1.2.5.14 Firewall

A firewall protects your network from unauthorized Internet traffic. The primary function of a firewall is to let authorized traffic pass through while unauthorized traffic gets blocked. Firewalls can be implemented in both hardware and software, or a combination of both. Firewalls are frequently used to prevent unauthorized Internet users from accessing private networks connected to the Internet, especially Intranets. All messages entering or leaving the Intranet pass through the firewall, which examines each message and blocks those that do not meet the specified security criteria.

Motorola's RFS7000 offers a hardware assisted stateful firewall that can route traffic at line rate (4 Gbps, full duplex). Some common attacks checked by a RFS7000 supported firewall include:

- *LAND attack*
- *IP Fragments overlap*
- *TCP XMAS Scan*
- *TCP NULL Scan*
- *TCP FIN Scan*
- *IP TTL zero*
- *Misuse of TCP URG offset*
- *Disallowing IP source route option*
- *TCP short header*

- *TCP Bad Sequence number*

Apart from detecting the above attacks, the firewall also performs sanity checks on every packet. These sanity checks can drop a packet if the packet is malformed. A log message is generated whenever a packet gets dropped due to these sanity checks. Logging provides details explaining the reason for dropping a packet along with the packet information - source IP, destination IP, source port, destination port, IP protocol etc.

Stateful Layer 3 Packet Filtering Capabilities

In addition to guarding against protocol abuses and *denial of service* (DoS) attacks, the RFS7000 provides powerful packet filtering capabilities. Standard IP and Extended IP ACLs are supported. These ACL's allow an administrator to filter packets based on a source IP address, destination IP address, source port, destination port, protocol type and even protocol options. For example, an administrator may choose to deny all UDP packets originating from subnet 10.1.1.0, which contains port number 27960 (used by popular games like Enemy Territory and Quake 3). When a packet matches a firewall rule, an administrator can choose to permit, deny or mark the packet. Packet marking allows an administrator to modify the IP TOS field. A log entry can also be created based on a firewall match.

Layer 2 Packet Filtering Capabilities

In some networks, a majority of the traffic flow could be switched rather than routed. In these instances, the RFS7000 provides Layer 2 packet filtering allowing administrators to define MAC address based rules. MAC ACL's can be defined based on a source MAC address, destination MAC address, VLAN ID, 802.1p priority or ethertype (IPV4, ARP, RARP, AppleTalk, AARP, 802.1q, IPX) of the packet. For example, an administrator may define a Layer 2 ACL that could deny all AppleTalk traffic originating from any MAC address. When a packet matches a firewall rule, an administrator can choose to permit, deny or mark the packet. Packet marking allows an administrator to modify the 802.1p or IP TOS field. A log entry can also be created based on a firewall match. In addition to MAC based ACL's, Standard IP ACL and Extended IP ACL's can also be applied to Layer 2 interfaces.

The RFS7000 provides filtering capabilities to prevent Layer 2 bridging between wireless users. In addition, a Standard IP ACL, Extended IP ACL or a MAC ACL can be applied to a WLAN interface. For example, this allows an administrator to deny DHCP Discover packets from being broadcasted on the air thus saving RF bandwidth.

In summary, the RFS7000 contains:

- Built-in Firewall protection (always on)
- Easy to use stateful firewall with zero-config
- Powerful packet filtering capability at Layer 3, Layer 2 and wireless interfaces
- Real time notification of Live attack

1.2.5.15 Certificate Management

Certificate Management is used to provide a standardized procedure to:

- Generate a certificate request and upload the server certificate signed by a *certificate authority* (CA).
- Upload a CA's root certificate.
- Create a self-signed certificate.

Certificate management is used by the applications HTTPS, VPN, HOTSPOT and Radius. For information on configuring switch certificate management, see *Creating Server Certificates on page 6-86*.

1.2.5.16 NAC

There is an increasing proliferation of insecure devices (laptops, mobile computers, PDA, smart-phones) accessing WiFi networks. These devices often lack proper anti-virus software and can potentially infect the network they access. Device compliance per an organization's security policy must be enforced using NAC. A typical security compliance check entails verifying the right operating system patches, anti-virus software etc.

NAC is a continuous process for evaluating MU credentials, mitigating security issues, admitting MUs to the network and monitoring MUs for compliance with globally-maintained standards and policies. If a MU is not in compliance, network access is restricted by quarantining the MU.

Using NAC, the switch hardware and software grants access to specific network devices. NAC performs a user and MU authorization check for devices without a NAC agent. NAC verifies a MU's compliance with the switch's security policy. The switch supports only EAP/802.1x NAC. However, the switch provides a mean to bypass NAC authentication for MU's without NAC 802.1x support (printers, phones, PDAs etc.).

For information on configuring NAC support, see *Configuring NAC Server Support on page 4-47*.

To review a NAC configuration example using the switch CLI, see *NAC Configuration Examples Using the Switch CLI on page 4-73*.

1.2.6 Access Port Support

Access ports work on any VLAN with switch connectivity. The switch supports AP300 model access ports:

CAUTION An access port is required to have a DHCP provided IP address before attempting layer 3 adoption, otherwise it will not work. Additionally, the access port must be able to find the IP addresses of the switches on the network. To locate switch IP addresses on the network:

- Configure DHCP option 189 to specify each switch IP address.
- Configure a DNS Server to resolve an existing name into the IP of the switch. The access port has to get DNS server information as part of its DHCP information. The default DNS name requested by an AP300 is "Symbol-CAPWAP-Address". However, since the default name is configurable, it can be set as a factory default to whatever value is needed.

For information defining the switch access port support scheme, see *Viewing Access Port Radio Information on page 4-84*.

2

Switch Web UI Access & Image Upgrades

2.1 Accessing the Switch Web UI

2.1.1 Web UI Requirements

The switch Web UI is accessed using Internet Explorer version5.5 (or later) and SUN JRE (*Java Runtime Environment*) 1.5 (or later). Refer to the Sun Microsystems Web site for information on downloading JRE.

NOTE To successfully access the switch Web UI through a firewall, UDP port 161 must be open in order for the switch's SNMP backend to function.

To prepare Internet Explorer to run the Web UI:

1. Open IE's **Tools** > **Internet Options** panel and select the **Advanced** tab.
2. Uncheck the following checkboxes:
   - Use HTTP 1.1
   - Java console enabled (requires restart)
   - Java logging enabled
   - JIT compiler for virtual enabled (requires restart).

2.1.2 Connecting to the Switch Web UI

To display the Web UI, launch a Web browser on a computer with the capability of accessing the switch.

NOTE Ensure you have HTTP connectivity to the switch, as HTTP is a required to launch the switch Web UI from a browser.

To display the switch Web UI:

1. Point the browser to the IP address assigned to the wired Ethernet port (port 2). Specify a secure connection using the **https://** protocol.

   The switch login screen displays:

2. Enter the User ID **admin,** and Password **superuser.** Both are case-sensitive. Click the **Login** button.

NOTE If using HTTP to login into the switch, you may encounter a Warning screen if a self-signed certificate has not been created and implemented for the switch. This warning screen will continue to display on future login attempts until a self-signed certificate is implemented. Motorola recommends only using the default certificate for the first few login attempts until a self-signed certificate can be generated.

NOTE If your password is lost, there is a means to access the switch, but you are forced to revert the switch back to its factory default settings and lose your existing configuration (unless saved to a secure location). Consequently, Motorola recommends keeping the password in a secure location so it can be retrieved. For information on password recovery, see *Switch Password Recovery on page 2-3*.

Once the Web UI is accessed, the Switch main menu item displays a configuration tab with high-level switch information. Click the **Show Dashboard** button to display an overall indicator of switch health. Once the switch is fully configured, the dashboard is the central display for the user to view the version of firmware running on the switch, quickly assess the last 5 alarms generated by the

switch, view the status of the switch's Ethernet connections and view switch CPU and memory utilization statistics.

NOTE The chapters within this *System Reference Guide* are arranged to be complimentary with the main menu items in the menu tree of the Web UI. Refer to this content to configure switch network addressing, security and diagnostics as required.

2.2 Switch Password Recovery

If the switch Web UI password is lost, you cannot get passed the Web UI login screen for any viable switch configuration activity. Consequently, a password recovery login must be used that will default your switch back to its factory default configuration.

To access the switch using a password recovery username and password:

CAUTION Using this recovery procedure erases the switch's current configuration and data files from the switch /flash dir. Only the switch's license keys are retained. You should be able to log in using the default username and password (admin/ superuser) and restore the switch's previous configuration (if exported to a secure location before the password recovery procedure was invoked).

1. Connect a terminal (or PC running terminal emulation software) to the serial port on the front of the switch.

   The switch login screen displays. Use the following CLI command for normal login process:

   ```
   RFS7000 login: cli
   ```

2. Enter a password recovery username of **restore** and password recovery password of **restoreDefaultPassword**.

   ```
   User Access Verification

   Username: restore
   Password: restoreDefaultPassword

   WARNING: This will wipe out the configuration (except license key) and
   user data under "flash:/" and reboot the device
   Do you want to continue? (y/n):
   ```

3. Press **Y** to delete the current configuration and reset factory defaults.

   The switch will login into the Web UI with its reverted default configuration. If you had exported the switch's previous configuration to an external location, it now can be imported back to the switch.

3

Switch Information

This chapter describes the Switch main menu information used to configure the RFS7000. This chapter consists of the following sections:

- *Viewing the Switch Interface*
- *Viewing Switch Port Information*
- *Viewing Switch Configurations*
- *Viewing Switch Firmware Information*
- *Switch File Management*
- *Configuring Automatic Updates*
- *Viewing the Switch Alarm Log*
- *Viewing Switch Licenses*
- *How to use the Filter Option*

NOTE HTTPS must be enabled to access the switch applet. Ensure HTTPS access has been enabled before using the login screen to access the switch applet.

3.1 Viewing the Switch Interface

The Switch **Configuration** tab provides high-level system, switch name and address information accessible from one location. Use this information to assess whether the current firmware version is the most recent and if the number of licenses available is correct to support the number of radio devices deployed. The values displayed within the screen can be defined in numerous additional locations throughout the switch applet.

NOTE The *Motorola RF Management Software* is a recommended utility to plan the deployment of the switch and view its interface statistics once operational in the field. Motorola RFMS can help optimize the positioning and configuration of a switch (and its associated radios) in respect to a WLAN's MU throughput requirements and can help detect rogue devices. For more information, refer to the Motorola Web site.

Refer to the switch configuration tab for:

- *Viewing the Switch Configuration*
- *Viewing Switch Statistics*

NOTE When the switch's configuration is successfully updated (using the Web UI), the effected screen is closed without informing the user their change was successful. However, if an error were to occur, the error displays within the effected screen's Status field and the screen remains displayed. With file transfer operations, the transfer screen remains open during the transfer and remains open upon completion (with status displayed within the Status field).

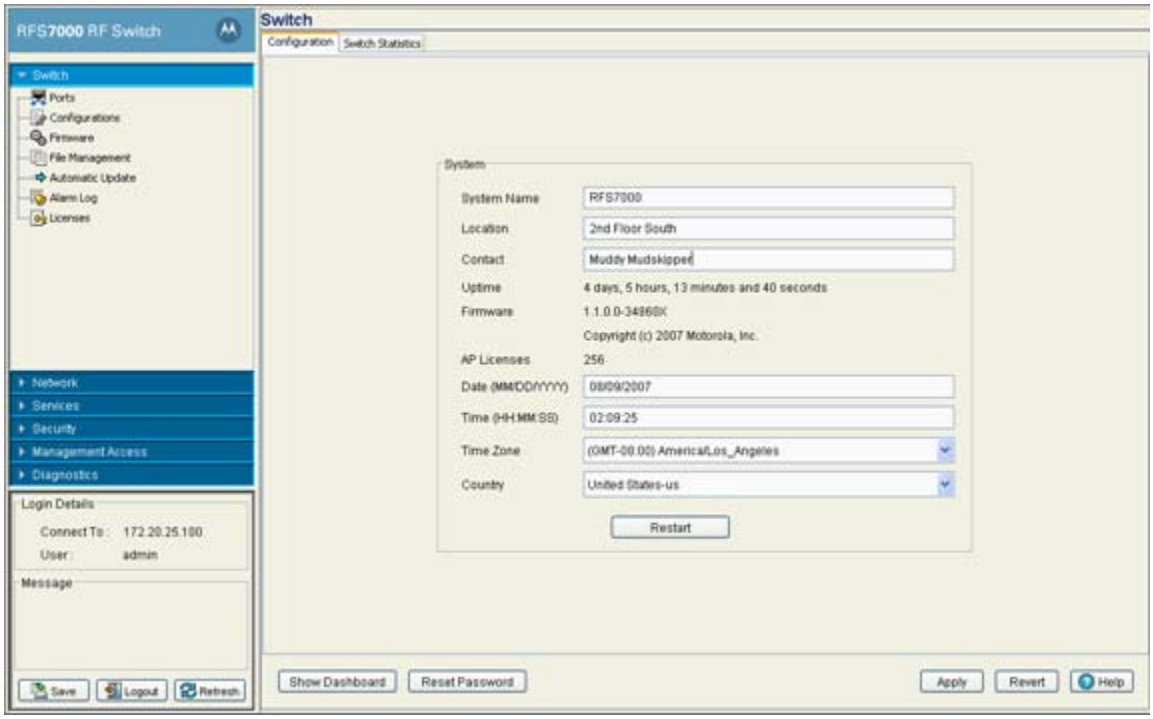
3.1.1 Viewing the Switch Configuration

The system requests the correct country code after the first login. A warning message may display stating an incorrect country setting will lead to the illegal use of the switch. Consequently, selecting the correct country is extremely important. Each country has its own regulatory restrictions concerning electromagnetic emissions (channel range) and the maximum RF signal strength transmitted. To ensure compliance with national and local laws, be sure to set the **Country** value correctly.

To view a high-level display of the switch configuration:

1. Select **Switch** from the main menu tree.

2. Select the **Configuration** tab



3. The system prompts the user for the correct **Country** code after the first login.

   A warning message could display stating that an incorrect country setting will lead to an illegal use of the switch. Selecting the correct country is extremely important. Each country has its own regulatory restrictions concerning electromagnetic emissions (channel range) and the maximum RF signal strength transmitted. To ensure compliance with national and local laws, be sure to set the Country correctly.

4. Review or set the following information as needed:

System Name	Displays the designated system name. Provide a system name serving as a reminder of the user base the switch supports (engineering, retail, etc.).
Location	The Location parameter serves as a reminder of where the switch can be found. Define the System Name as a specific identifier of the switch's location. Use the System Name and Location parameters together to optionally define the switch name by the radio coverage type it supports and physical location. For example, "second floor engineering."
Contact	Displays a **Contact** value for system administration and troubleshooting. This name should be the network administrator responsible for switch operations.
Uptime	Displays the current operational time for the device name defined within the System Name field. Uptime is the cumulative time since the switch was last rebooted or lost power.
Firmware	Displays the current firmware version running on the switch. This version should be periodically compared to the most recent version available on the Motorola Web site, as versions with increased functionality are periodically released

AP Licenses	Displays the number of access port licenses currently available for the switch. This value represents the maximum number of access ports the switch is licensed to adopt.
Date (MM/DD/YYYY)	Displays the day, month and year currently used with the switch.
Time	Displays the time of day used by the switch.
Time Zone	Use the drop-down menu to specify the time zone used with the switch. Adjusting the time zone will in turn, cause an adjustment to the time displayed.
Country	Use the drop-down menu to specify the correct country of operation.

5. Click the **Restart** button to reboot the switch. The switch itself does not include a hardware feature for this purpose.

CAUTION When restarting or rebooting the switch, the Radius server will also be restarted regardless of its state before the reboot.

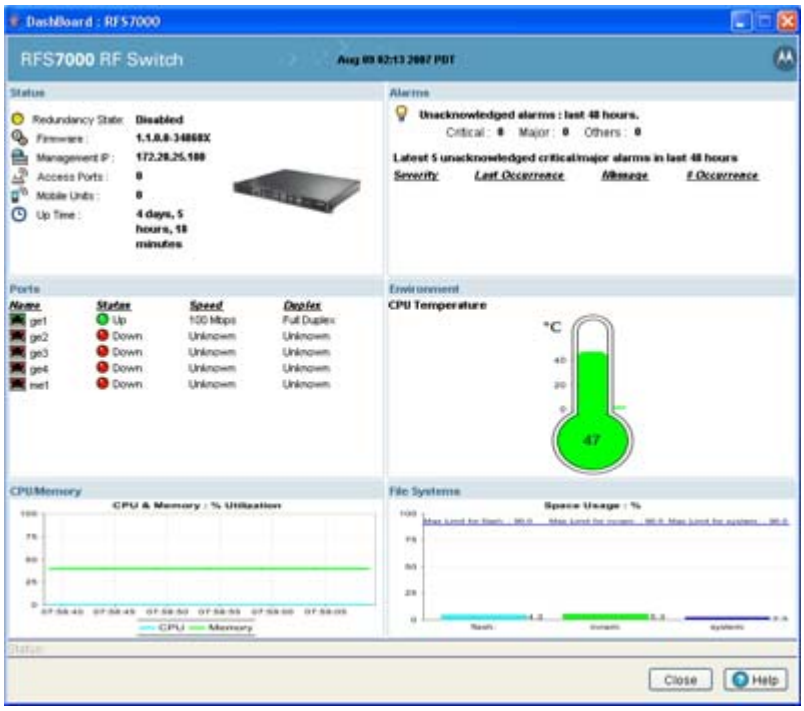
6. Click the **Show Dashboard** button to display a screen with indicators of switch health and status. For more information, see *Viewing Dashboard Details on page 3-4*.
7. Click the **Reset Password** button to display a screen to reset you password to a new value.

Enter the new password within the **Password** and **Confirm Password** fields and click **OK**.

8. Click the **Apply** button to save the updates.
9. Click the **Revert** button to undo any changes. Revert sets the values for the screen back to the last saved configuration.

3.1.1.1 Viewing Dashboard Details

The switch dashboard represents a high-level (graphical) overview of central switch processes. When logging into the switch, the dashboard should be the first place you go to assess overall switch performance and any potential performance issues. Click the **Show Dashboard** button (within the Switch screen's Configuration tab) to display the current health of the switch.



The **Dashboard** screen displays the current health of the switch and is divided into the following fields:

- *Alarms*
- *Ports*
- *Environment*
- *CPU Memory*
- *File Systems*

Apart from the sections mentioned above, it also displays the following:

Displays the **Redundancy State** of the switch. The status can be either Enabled or Disabled.

- *Enabled* — Displays green.
- *Disabled* — Displays yellow.

Displays the current **Firmware** version running on the wireless switch.

Displays the **Management IP** address of the switch.

Displays the total number of **Access Ports** adopted by the switch.

Displays the total number of **Mobile Units** associated with the switch.

Displays the switch uptime. The **Uptime** is the current operational time defined within the System Name field. Uptime is the cumulative time since the switch was rebooted or lost power.

1. Refer to the **Alarms** field for details of all the unacknowledged alarms generated during the past 48 hours. The alarms are classified as:
   - *Critical* — Denoted by a red indicator. These alarms warrant immediate attention.
   - *Major* — Denoted by a yellow indicator. These alarms warrant attention.
   - *Others* — Denoted by a blue indicator.

   The alarms field also displays details (in a tabular format) of the 5 most recent unacknowledged critical/major alarms raised during the past 48 hours. The table displays the following details:

Severity	Displays the severity of the alarm. The severity can be either Critical or Major.
Last Occurrence	Displays the time when the alarm was reported
Message	Displays the message associated with the alarm.
# Occurrences	Displays the number of times during the past 48 hours such an alarm was generated.

2. Refer to the **Ports** field for link, speed and duplex status of each physical port on the switch's front panel. It displays the following details in a tabular format:

Name	Displays the name of the port (ge1, ge2, ge3, ge4 and me1).
Status	Displays the status of the port, either— Up or Down
Speed	Displays the speed at which the port transmits or receives data.
Duplex	Displays the status of the port, either— Full Duplex or Unknown.

3. The **Environment** section displays the CPU. It displays the valid threshold range set by the user.
4. The **CPU/Memory** section displays how the switch CPU and memory are being utilized in real time.
5. The **File Systems** section displays the free file system available for:
   a. *flash*
   b. *nvram*
   c. *system*

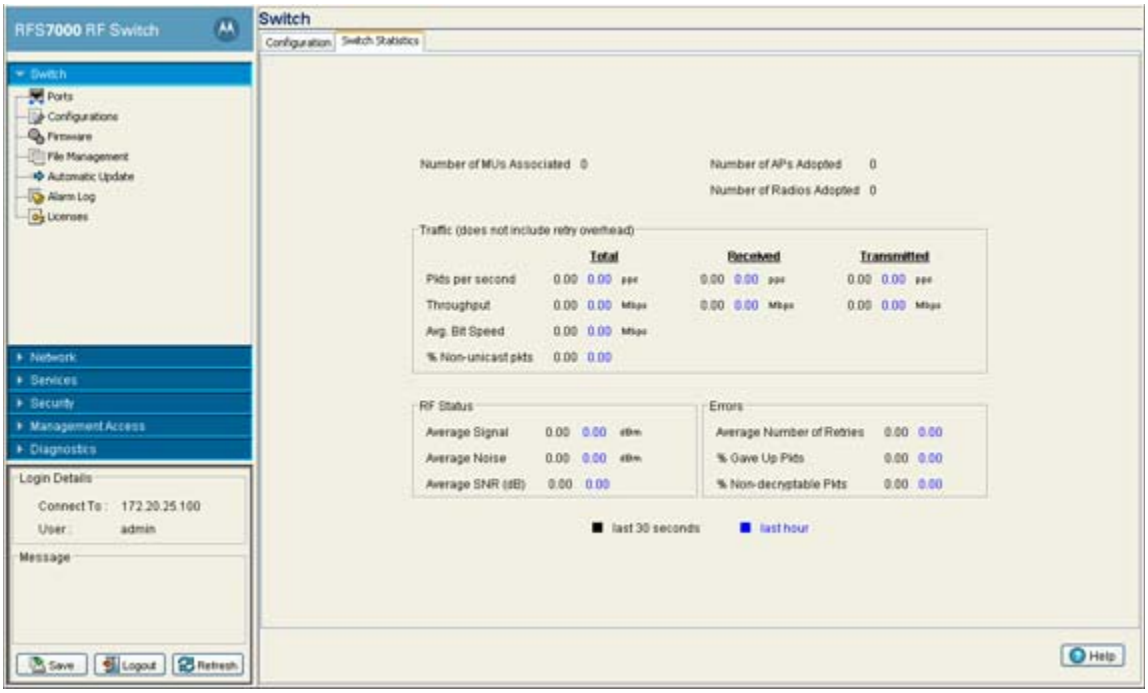
3.1.2 Viewing Switch Statistics

The **Switch Statistics** screen displays an overview of the recent network traffic and RF status for the switch.

To display the Switch Statistics tab:

1. Select **Switch** from the main menu tree.

2. Click the **Switch Statistics** tab at the top of the Switch screen.



3. Refer to the following read-only information about associated MUs:

Number of MUs Associated	Displays the total number of MUs currently associated to the switch.
Number of APs Adopted	Displays the total number of access ports currently adopted by the switch.
Number of Radios Adopted	Displays the total number of radios currently adopted by the switch.

4. Refer to the **Traffic** field for read-only network traffic information for associated APs and radios:

Pkts per second	Displays the packet transmission rate for received and transmitted packets over last 30 seconds and 1 hour.
Throughput	Displays the traffic throughput for packets received, packets transmitted and total packets over last 30 seconds and 1 hour. The throughput value can help identify network bandwidth and utilization issues negatively impacting performance.
Avg. Bit Speed	Displays the average bit speed for the switch over last 30 seconds and 1 hour. Use the average bit speed to help determine overall network speeds and troubleshoot network congestion.
% Non-unicast pkts	Displays the percentage of non-unicast packets detected (received & transmitted) by the switch over last 30 seconds and 1 hour. Non-unicast traffic includes both multicast and broadcast traffic.

5. The **RF Status** field displays the following read-only RF radio signal information for associated APs and radios:

Average Signal	Displays the average signal strength for MUs associated with the switch over the last 30 seconds and 1 hour.

Average Noise	Displays the average RF noise for all MUs associated with the selected WLAN. MU noise for the last 30 seconds is displayed in black and the number in blue represents MU noise for the last hour.
Average SNR (dB)	Displays the average *Signal to Noise Ratio* (SNR) for all MUs associated with the switch. The Signal to Noise Ratio is an indication of overall RF performance on your wireless network.

6. Refer to the **Errors** field for the following read-only packet error and loss information for associated access ports and radios:

Average Number of Retries	Displays the average number of retries for all MUs associated with the switch. The number in black represents average retries for the last 30 seconds and the number in blue represents average retries for the last hour.
% Gave Up Pkts	Displays the percentage of packets which the switch gave up on for all MUs associated with the switch. The number in black represents this statistic for the last 30 seconds and the number in blue represents this statistic for the last hour.
% Non-decryptable Pkts	Displays the percentage of undecryptable packets for all MUs associated with the switch. The number in black represents undecryptable pkts for the last 30 seconds and the number in blue represents undecryptable pkts for the last hour.

3.2 Viewing Switch Port Information

The **Port** screen displays the configuration, runtime status and statistics of Ethernet Port 1 and Ethernet port 2. The Port screen consists of the following tabs:

- *Configuration*
- *Runtime*
- *Statistics*

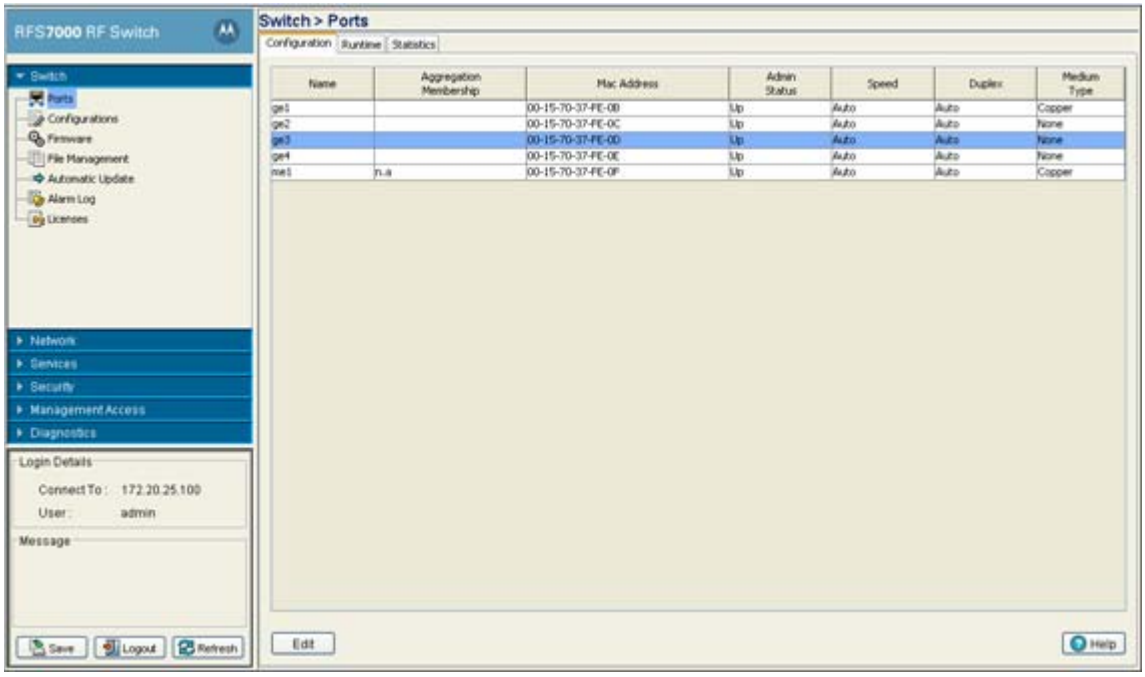
3.2.1 Viewing the Port Configuration

The **Configuration** tab displays the current configuration of the switch ports. Use this information to determine whether an existing port configuration can be used as is, or requires modification to be valid within the switch managed network.

To view configuration details for the uplink and downlink ports:

1. Select **Switch** > **Port** from the main menu tree.

2. Select the **Configuration** tab to display the following read-only information:



Name	Displays the port name.
Aggregation Membership	Displays the **Channel Group** defined for the port (if any). The switch bundles individual Ethernet links (over the selected channel) into a single logical link that provides bandwidth between the switch and another switch or host. The port speed used is dependant on whether full or half duplex is selected. If a segment within a channel fails, traffic previously carried over the failed link is routed to the remaining segments within the channel. A trap is sent upon a failure identifying the switch, channel and failed link. A group 0-4 designation can be defined by selecting a port and clicking the **Edit** button at the bottom of the screen.
MAC Address	Displays the port's MAC Address. This value is read-only, set at the factory and cannot be modified.
Admin Status	Displays whether the port is currently Up or Down.
Speed	Displays the current speed of the data transmitted and received over the port.
Duplex	Displays the port as either half or full duplex.
Medium Type	Displays the medium (physical connection type) used by the displayed port name. Potential port mediums include **Fiber** (fiber optic connection), **Cooper** and **None**.

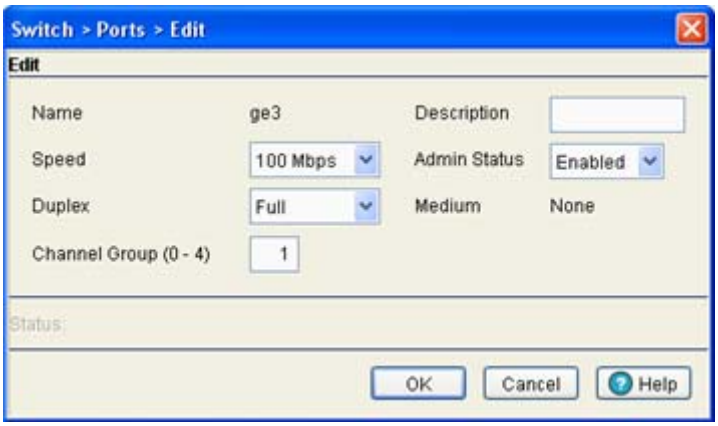
3. Select a port and click the **Edit** button to modify the port's configuration. For additional information, see *Editing the Port Configuration on page 3-10*.

3.2.1.1 Editing the Port Configuration

To modify the port configuration:

1. Select a port from the table displayed within the Configuration tab.
2. Click the **Edit** button.

   A **Port Change Warning** screen displays, stating any change to the port setting could disrupt access to the switch. Communication errors may occur even if modifications made are successful.
3. Click the **OK** button to continue.
4. Use the **Edit** screen to modify the configuration for the selected port.



Name — Displays the read-only name assigned to the port.

Speed — Select the speed the port can receive and transmit data. Select a value from the following ranges:

- *10 Mbps*
- *100 Mbps*
- *1000 Mbps*
- *Auto*

Duplex — Modify the switch duplex by selecting one of the following options:

- *Half*
- *Full*
- *Auto*

Channel Group (0-4) — Optionally set the **Channel Group (0-4)** defined for the port. The switch bundles individual Ethernet links (over the selected channel) into a single logical link that provides bandwidth between the switch and another switch or host. The port speed used is dependant on the Duplex value selected (full, half or auto). If a segment within a channel fails, traffic previously carried over the failed link is routed to the remaining segments within the channel. A trap is sent upon a failure identifying the switch, channel and failed link.

Description — Enter a brief description for the port.

Admin Status — Either Enable (activate) or Disable (inactivate) the admin status of the port.

Medium	Displays the current (read-only) connection medium used by this port.

Read-only details about the port's cabling connection also display within the Edit screen. This information should be used to help assess what configuration should be set for this port.

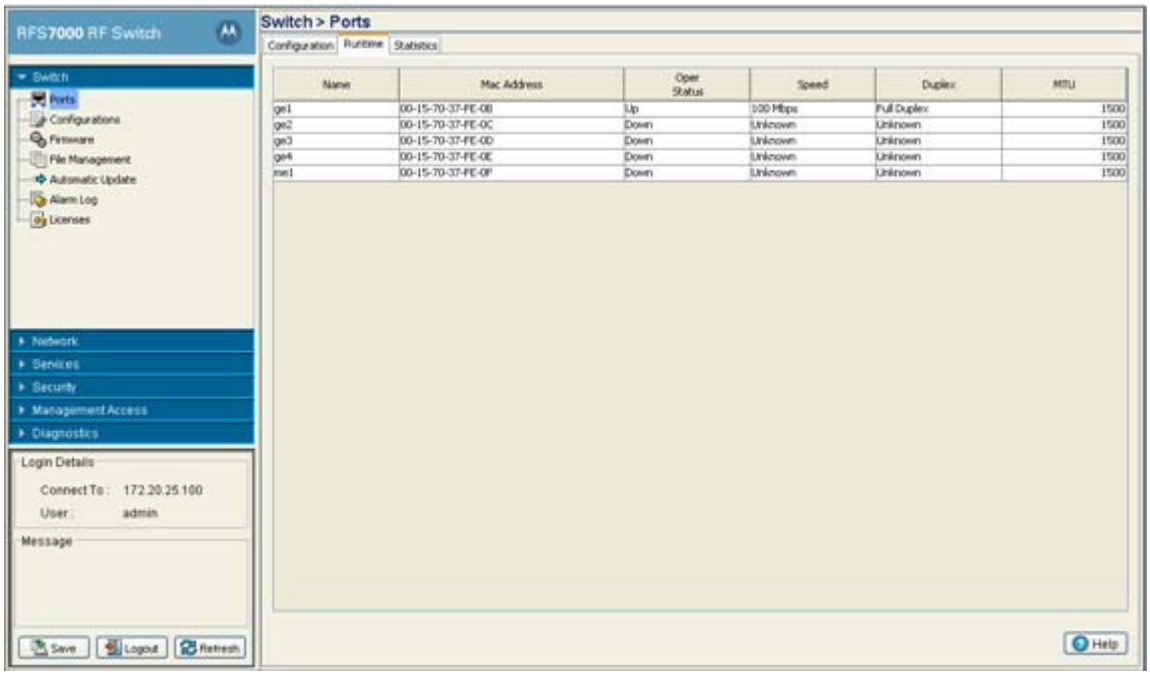
5. Click the **OK** button to commit the changes made to the port configurations.
6. Click **Cancel** to disregard any changes and revert back to the last saved configuration.

3.2.2 Viewing the Ports Runtime Status

The Runtime tab displays the read-only runtime configuration for uplink and downlink ports.

To view the runtime configuration details of the uplink and downlink ports:

1. Select **Switch** > **Port** from the main menu tree.



2. Select the **Runtime** tab to display the following read-only information:

Name	Displays the port name for which the remaining data represents.
MAC Address	Displays the port's MAC Address. This value is read-only, set at the factory and cannot be modified.
Oper Status	Displays the operational status of the port. The port status can be either Up or Down.
Speed	Displays the current speed of the data transmitted and received over the port.
Duplex	Displays the port as either half or full duplex.

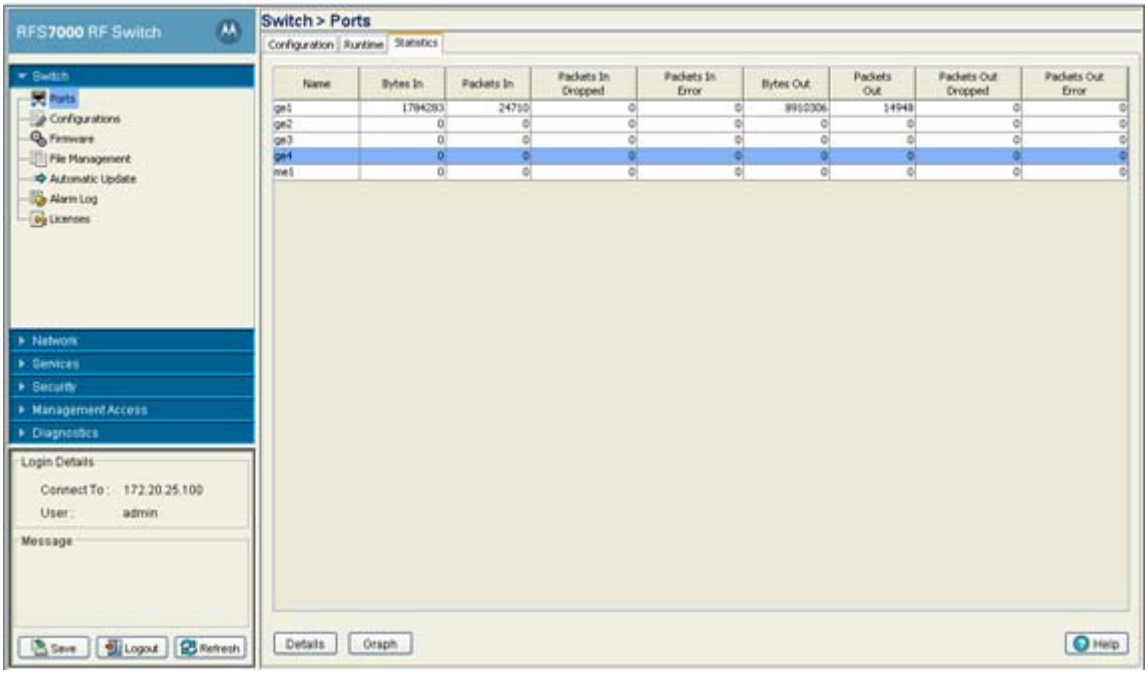
MTU	Displays the *maximum transmission unit* (MTU) setting configured on the port. The MTU value represents the largest packet size that can be sent over a link. The MTU is determined by the underlying network, but must be taken into account at the IP level. IP packets (which can be up to 64K bytes each) must be packaged into lower-level packets of the appropriate size for the underlying network(s) and re-assembled on the other end. 10/100 Ethernet ports have a maximum MTU setting of 1500.

3.2.3 Viewing the Ports Statistics

The **Statistics** tab displays read-only statistics for uplink and downlink ports. Use this information to assess if configuration changes are required to improve network performance.

To view the runtime configuration details of the uplink and downlink ports:

1. Select **Switch** > **Port** from the main menu tree.
2. Select the **Statistics** tab.



3. Refer to the Statistics tab to display the following read-only information:

Name	Defines the port name (as either ge 1-4 or me1).
Bytes In	Displays the total number of bytes received by the port.
Packets In	Displays the total number of packets received by the port.
Packets In Dropped	Displays the number of packets dropped by the port. If the number appears excessive, a different port may be required.
Packets In Error	Displays the number of erroneous packets received by the port. If the number appears excessive, a different port may be required.
Bytes Out	Displays the total number of bytes transmitted by the port.

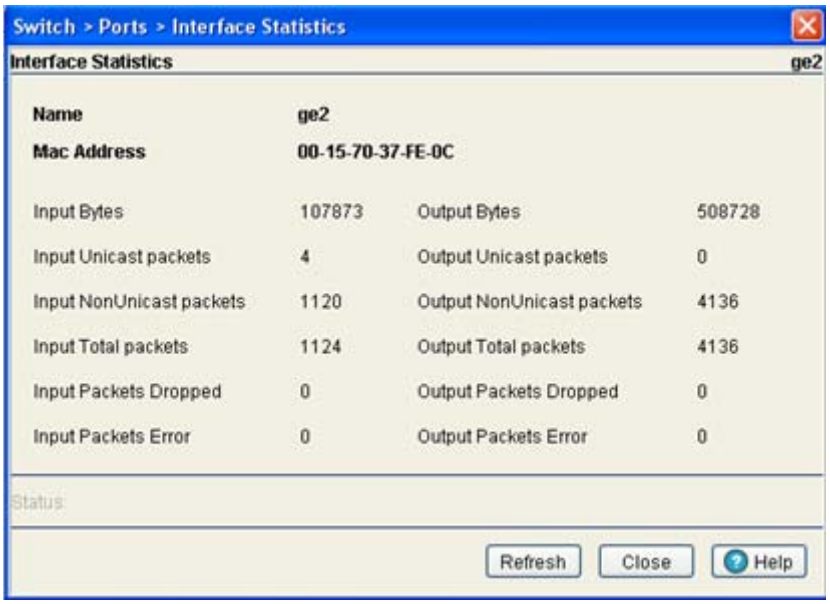
Packets Out	Displays the total number of packets transmitted (sent) by the port. A low value could be an indication of a network problem.
Packets Out Dropped	Displays the total number of transmitted packets dropped. A high value may be an indication of network issues.
Packets Out Error	Displays the total number of erroneous transmitted packets.

4. Select a port and click on **Details** button to see the detailed port statistics. For more information, refer to *Detailed Port Statistics on page 3-13*.
5. Select a port and click the **Graph** button to view port statistics in a graphical format. For more information, refer to *Viewing the Port Statistics Graph on page 3-15*.

3.2.3.1 Detailed Port Statistics

To view detailed statistics for a port:

1. Select a port from the table displayed within the Statistics screen.
2. Click the **Details** button.



3. The **Interface Statistics** screen displays. This screen provides the following statistics for the selected port:

Name	Displays the port name.
MAC Address	Displays physical address information associated with the interface. This address is read-only (hard-coded at the factory) and cannot be modified.
Input Bytes	Displays the number of bytes received over the interface.
Input Unicast Packets	Displays the number of unicast packets (packets directed towards the interface) received over the interface.
Input NonUnicast Packets	Displays the number of NonUnicast Packets (Multicast and Broadcast Packets) received over the interface.
Input Total Packets	Displays the total number of packets received over the interface.

Input Packets Dropped	Displays the number of received packets dropped at the interface by the input Queue of the hardware unit /software module associated with the interface. Packets are dropped when the input Queue of the interface is full or unable to handle incoming traffic.
Input Packets Error	Displays the number of received packets with errors at the interface. Input Packet Errors are input errors occurring due to; no buffer space/ignored packets due to broadcast storms, packets larger than maximum packet size, framing errors, input rate exceeding the receiver's date handling rate or cyclic redundancy check errors. In all these cases, an error is reported.
Output Bytes	Displays the number of bytes transmitted from the interface.
Output Unicast Packets	Displays the number of unicast packets (packets directed towards a single destination address) transmitted from the interface.
Output NonUnicast Packets	Displays the number of unicast packets transmitted from the interface.
Output Total Packets	Displays the total number of packets transmitted from the interface.
Output Packets Dropped	Displays the number of transmitted packets dropped at the interface. Output Packets Dropped are the packets dropped when the output queue of the physical device associated with interface is saturated.
Output Packets Error	Displays the number of transmitted packets with errors at the interface. Output Packet Errors are the sum of all the output packet errors, malformed packets and misaligned packets received on an interface.

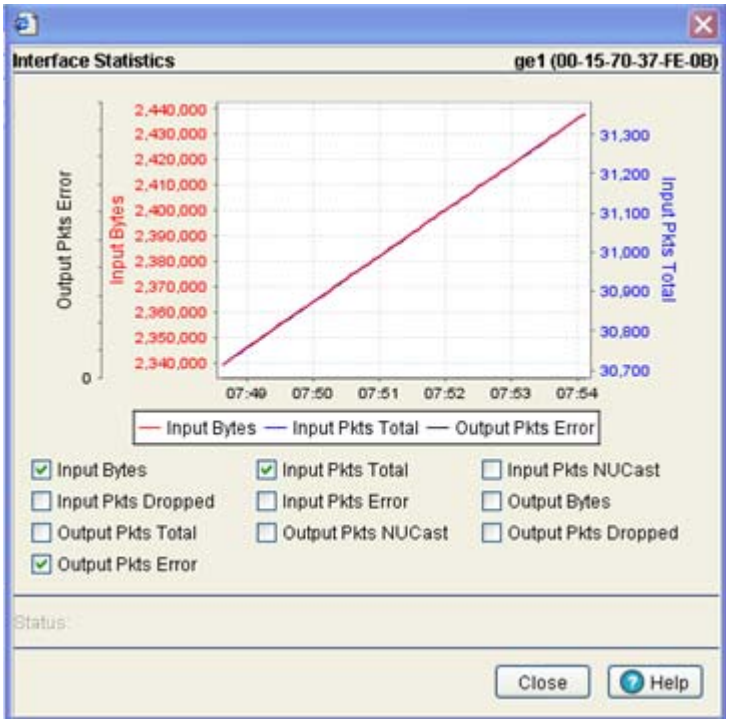
4. The **Status** is the current state of the requests made from the applet. Requests are any “SET/GET” operation from the applet. The Status field displays error messages if something goes wrong in the transaction between the applet and the switch.
5. Click on the **Refresh** button to refresh the port statistics.
6. Click on the **Close** button to exit out of the screen.

3.2.3.2 Viewing the Port Statistics Graph

The switch continuously collects data for port statistics. Even when the port statistics graph is closed, data is still tallied. Periodically display the port statistics graph for assessing the latest information.

To view a detailed graph for a port:

1. Select a port from the table displayed in the Statistics screen.
2. Click the **Graph** button.



The **Interface Statistics** screen displays for the selected port. The screen provides the option to view statistics for the following:

- *Input Bytes*
- *Input Pkts Dropped*
- *Output Pkts Total*
- *Output Pkts Error*
- *Input Pkts Total*
- *Input Pkts Error*
- *Output Pkts NUCast*
- *Input Pkts NUCast*
- *Output Bytes*
- *Output Pkts Dropped*

3. Display any of the above parameters by selecting the checkbox associated with it.

NOTE You are not allowed to select (and display) more than four parameters at any given time.

4. Click on the **Close** button to exit the screen without saving changes.

3.3 Viewing Switch Configurations

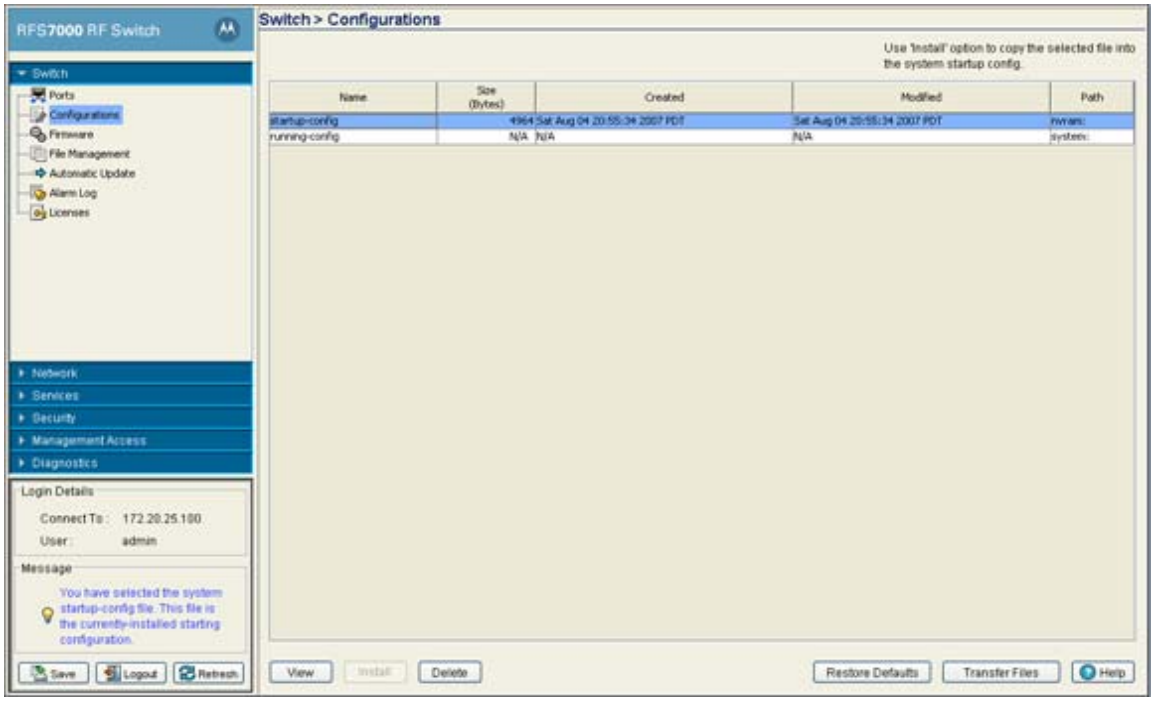
Use the **Configurations** screen to review the configuration files available to the switch. The details of each configuration can be viewed individually. Optionally, edit the file to modify its name or use the file as the switch startup configuration. A file can be deleted from the list of available configurations or transferred to a user specified location.

NOTE To view the entire switch configuration using SNMP, the switch CLI provides a better medium to review the entire switch configuration.

NOTE The *Motorola RF Management Software* is a recommended utility to plan the deployment of the switch and view its configuration once operational in the field. Motorola RFMS can help optimize the positioning and configuration of a switch (and its associated radios) in respect to a WLAN's MU throughput requirements and can help detect rogue devices. For more information, refer to the Motorola Web site.

To view the configuration files available to the switch:

1. Select **Switch** > **Configurations** from the main menu tree.



The following information is displayed in tabular format. Configuration files (with the exception of startup-config and running-config) can be edited, viewed in detail or deleted.

Name	Displays a list of existing configuration files that can be used with the switch.
Size (Bytes)	Displays the size (in bytes) of each available configuration file.

Created	Displays the date and time each configuration file was created. Use this information as a baseline for troubleshooting problems by comparing event log data with configuration file creation data.
Modified	Displays the date and time each configuration file was last modified. Compare this column against the Created column to discern which files were modified and make informed decisions whether existing files should be further modified or deleted.
Path	Displays the path (location) to the configuration file.

2. To view the entire contents of a config file (in detail), select a config file (by highlighting a row from the table) and click the **View** button. For more information, see *Viewing the Detailed Contents of a Config File on page 3-17*.
3. Select a configuration (other than the start-up-config or running config) and click the **Install** button to install the file on the switch and replace the existing startup-config file.

   If a file (for example, *sample-config*) is selected, a message displays stating, "When *sample-config* is installed, it will replace start-up config. Are you sure you want to install *sample-config.*" Click **Yes** to continue.

NOTE Selecting either the startup-config or running-config does not enable the Install button. A different configuration file must be available to enable the Install button for the purposes of replacing the existing startup-config.

4. To permanently remove a file from the list of configurations available to the switch, select a configuration file and click the **Delete** button.

   If startup-config is deleted, a prompt displays stating the default switch startup-config will automatically take its place. The switch running-config cannot be deleted.
5. To restore the system's default configuration file and revert the settings back to their factory default, click the **Restore Defaults** button.

NOTE After setting the switch to revert to factory default settings, the system must be rebooted before the factory default settings take effect. When this occurs, the switch IP address could change.

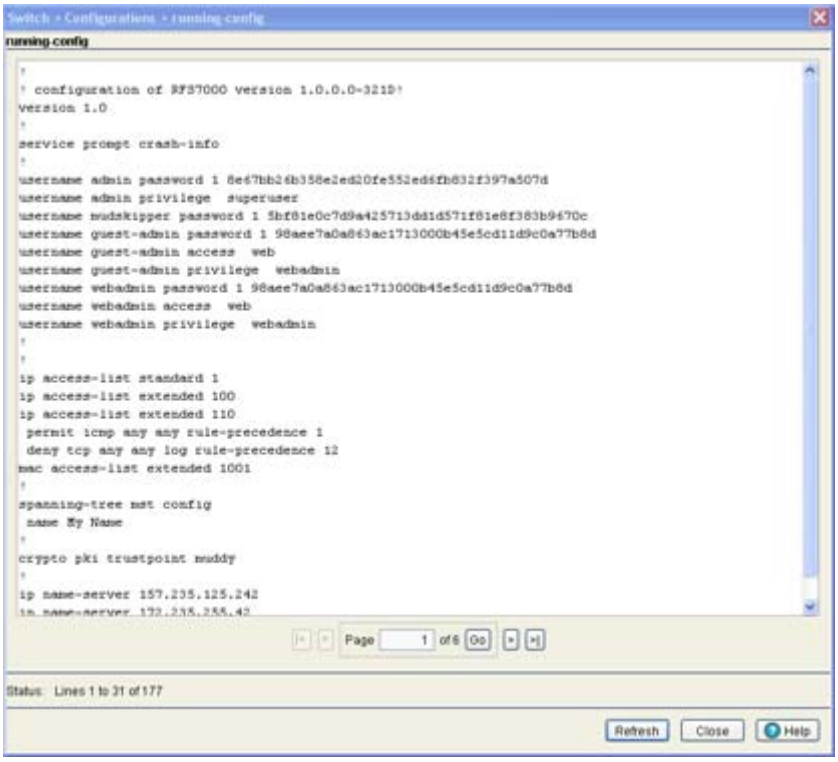
6. Click the **Transfer Files** button to move a target configuration file to a secure location for later use. For more information, see *Transferring a Config File on page 3-18*.

3.3.1 Viewing the Detailed Contents of a Config File

The View screen displays the entire contents of a configuration file. Motorola recommends a file be reviewed carefully before it is designation as the switch startup configuration.

1. Select a configuration file from the Configuration screen.

2. Click the **View** button to see the contents of the selected configuration file.



3. The **Main** screen displays the contents of the configuration file.

   Use the up and down navigation facilities on the right-hand side of the screen to view the entire file.

4. The **Page** parameter displays the portion of the configuration file currently displayed in the main viewing area.

   The total number of pages in the file are displayed to the right of the current page. The total number of lines in the file display in the Status field at the bottom of the screen.

   Scroll to corresponding pages as required to view the entire contents of the file. To navigate to a specific page, enter the page number in the text area (next to the Page item) and click the **Go** button. The source parameter differs depending on the source selected.

5. Refer to the **Status** field for the current state of the requests made from the applet. Requests are any "SET/GET" operation from the applet. The Status field displays error messages if something goes wrong in the transaction between the applet and the switch.
6. Click the **Refresh** button to get the most recent updated version of the configuration file.
7. Click **Close** to close the dialog without committing updates to the running configuration.

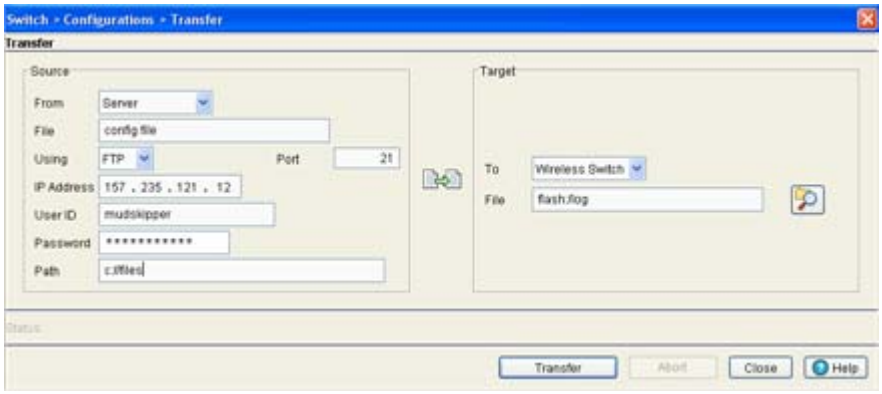
3.3.2 Transferring a Config File

Transfer a configuration file to and from the switch using the **Transfer** screen. Transferring the switch configuration is recommended to keep viable configurations available in a secure location. The following file transfer configurations are possible:

- *switch to switch, server or local disk*
- *server to switch*
- *local disk to switch*

To transfer the contents of a configuration file:

1. Click the **Transfer Files** button on the bottom of the Configuration screen.



2. Refer to the **Source** field to define the location and address information for the source config file.

From	Select the location representing the source file's current location using the **From** drop-down menu. Options include **Server, Local Disk** and **Wireless Switch**.
File	Specify a source file for the file transfer. If the switch is selected, the file used at startup automatically displays within the File parameter.
Using	Use the **Using** drop down-menu to configure whether the log file transfer is conducted using FTP or TFTP. FTP transfers require a valid user ID and password.
Port	Specify the **Port** number used for the configuration file transfer. The default port number for FTP transfers in 21, and the default port for TFTP transfers is 69.
IP Address	Enter the **IP Address** of the server or system receiving the source configuration. Ensure the IP address is valid or risk jeopardizing the success of the file transfer.
User ID	Enter the **User ID** credentials required to transfer the configuration file from a FTP server.
Password	Enter the **Password** required to send the configuration file from an FTP server.
Path	Specify the appropriate **Path** name to the target directory on the local system disk or server. The Target options are different depending on the target selected.

3. Refer to the **Target** field to specify the details of the target file.

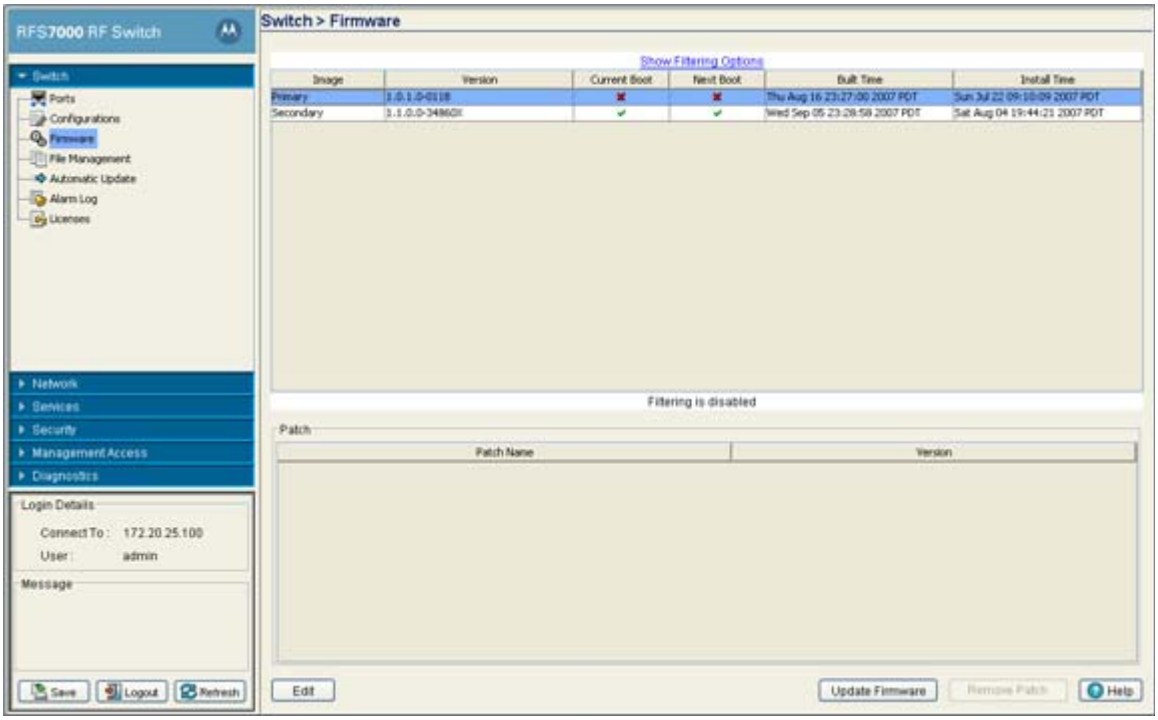
To	Use the **To** drop-down menu to define the location of the configuration file. Options include the Wireless Switch (default location), Server (only available when source is Wireless Switch) or Local Disk (only available when source is Wireless Switch).
File	Use the **File** field to specify a target file for the file transfer. Use the File Browser icon to search attached files systems for target file location.

File Browser (icon)	If the target specified is Wireless Switch, click the File Browser icon to specify the target file's location on the switch. The target location can be any of the three file systems on the switch: Flash, System or NVRAM. In addition to the three built-in file systems additional targets are CF, for Compact Flash and USB1 and USB2 for USB flash memory drives. The CF, USB1 and USB2 options are only available when Compact Flash or USB flash memory cards are plugged into the switch. For additional information on installing Compact Flash cards or USB flash memory drives, refer to the switch installation guide.

4. Refer to the **Status** field for the current state of the requests made from the applet. Requests are any "SET/GET" operation from the applet. The Status field displays error messages if something goes wrong in the transaction between the applet and the switch.
5. Click the **Transfer** button when ready to move the target file to the specified location. Repeat the process as necessary to move each desired configuration file to the specified location.
6. Click the **Abort** button to cancel the file transfer process before it is complete.
7. Click the **Close** button to exit the Transfer screen and return to the Config Files screen. Once a file is transferred, there is nothing else to be saved within the Transfer screen.

3.4 Viewing Switch Firmware Information

The switch can store two software versions. Information about the two versions displays within the **Firmware** screen. The **Version** column displays the version string. The **Build Time** is the date and time each version was generated. **Install** represents the date and time the upgrade was performed. **Next Boot** indicates which version should be used on the next reboot. The Next Boot version should match the **Running Version**, unless the system has failed over to another version.



To view the firmware files available to the switch:

1. Select **Switch** > **Firmware** from the main menu tree.
2. Refer to the following information displayed within the Firmware screen:

Image	Displays whether a firmware image is the primary image or a secondary image. The primary image is typically the image loaded when the switch boots.
Version	Displays a unique alphanumeric version name for each firmware version listed.
Current Boot	A check mark within this column designates this version as the version used by the switch the last time it was booted. An **"X"** in this column means this version was not used the last time the switch was booted.
Next Boot	A check mark within this column designates this version as the version to be used the next time the switch is booted. An **"X"** in this column means this version will not be used the next time the switch is booted. To change the boot designation, highlight an image and click the **Edit** button.

Built Time	Displays the time the version was created (built). Do not confuse the Built Time with the time the firmware was last loaded on the switch.
Install Time	The Install Time is the time this version was loaded with on the switch.

3. Refer to the **Patch** field for a listing of those Patches available to the switch. The name and version of each patch file is displayed. Each patch file has an associated .txt file to go with it. the text file describes nuances associated with the file that may make it optimal for use with the switch.

NOTE If downgrading from 1.1.x firmware to 1.0.x firmware an additional patch must be installed prior to downgrading.

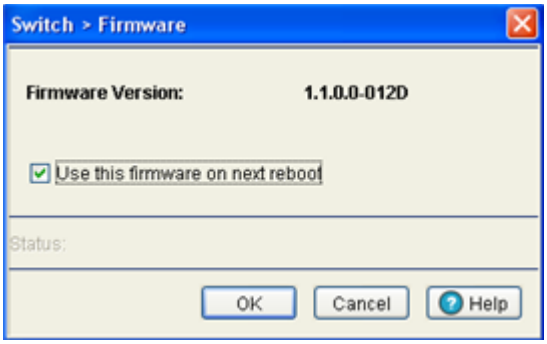
4. Select an existing firmware version and click the **Edit** button to change the version used when the switch is next booted. For more information, see *Editing the Switch Firmware on page 3-22*.
5. Click on the **Update Firmware** button to update the firmware file loaded onto the switch. For more information, see *Updating the Switch Firmware on page 3-23*.
6. To remove a patch, select it from amongst those displayed within the Patch field and click the **Remove Patch** button.

3.4.1 Editing the Switch Firmware

The Edit screen enables the user to select a firmware version and designate it as the version used the next time the switch is booted.

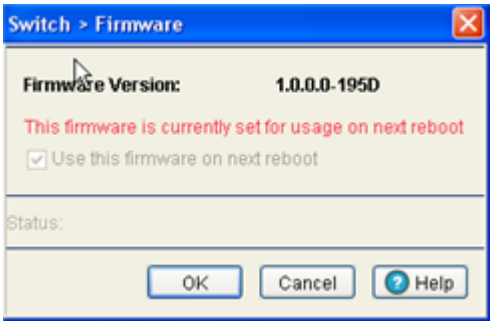
1. Select the primary firmware image from the Firmware screen.
2. Click the **Edit** button.

   The **Firmware** screen displays the current firmware version and whether this version is used for the next reboot.



3. Select the checkbox to use this version on the next boot of the switch.
4. To edit the secondary image, select the secondary image, click the **Edit** button and select the **Use this firmware on next reboot** checkbox.

This firmware version will now be invoked after the next reboot of the switch.



5. Refer to the **Status** field for the current state of the requests made from the applet. Requests are any "SET/GET" operation from the applet. The Status field displays error messages if something goes wrong in the transaction between the applet and the switch.
6. Click the **OK** button to commit the changes made and exit the screen.

3.4.2 Updating the Switch Firmware

Use the **Update** screen to update the firmware version currently used by the switch.

NOTE When performing a firmware update using the switch CLI, use the following syntax (specific to FTP) *ftp://username:password@ipaddress:port/path/filename*. If using TFTP, use *tftp://ipaddress/path/filename*.

1. Select an image from the table in the Firmware screen.
2. Click the **Update Firmware** button.

3. Use the **From** drop-down menu to specify the location from which the file is sent. CF (compact flash), USB1 & USB2 options are available in addition to the default Server setting which is used for FTP, TFTP, HTTP and SFTP transfers.
4. Enter the name of the file containing the firmware update in the **File** text field.

   This is the file that will replace the file currently in use.
5. From the **Using** drop down menu, select either FTP, TFTP, HTTP, SFTP as a medium to update the firmware.

a. Use **FTP** to get the firmware update from a *File Transfer Protocol* (FTP) server. A user account must be established on the FTP server specified for the firmware update.

b. Use **TFTP** to get the firmware update from a *Trivial File Transfer Protocol* (TFTP) server.

6. Enter the IP address for the FTP or TFTP server in the **IP address** field.
7. Enter the username for FTP server login in the **User ID** field.
8. Enter the password for FTP server login in the **Password** field.
9. Enter the complete file path for the file that contains the firmware update in the **Path** field.
10. Click the **Do Update** button to initiate the update.

    A warning prompt displays. Upon confirming the firmware update, the switch completes the firmware update.

CAUTION When restarting or rebooting the switch, the Radius server is restarted regardless of its state before the reboot.

11. Refer to the **Status** field for the current state of the requests made from the applet. Requests are any "SET/GET" operation from the applet. The Status field displays error messages if something goes wrong in the transaction between the applet and the switch.
12. Click **Close** to close the dialog without committing updates to the running configuration.

3.5 Switch File Management

Use the File Management screen to transfer configuration file to and from the switch and review the files available. The File Management screen consists of the following tabs:

- *Transfer Files*
- *File System*

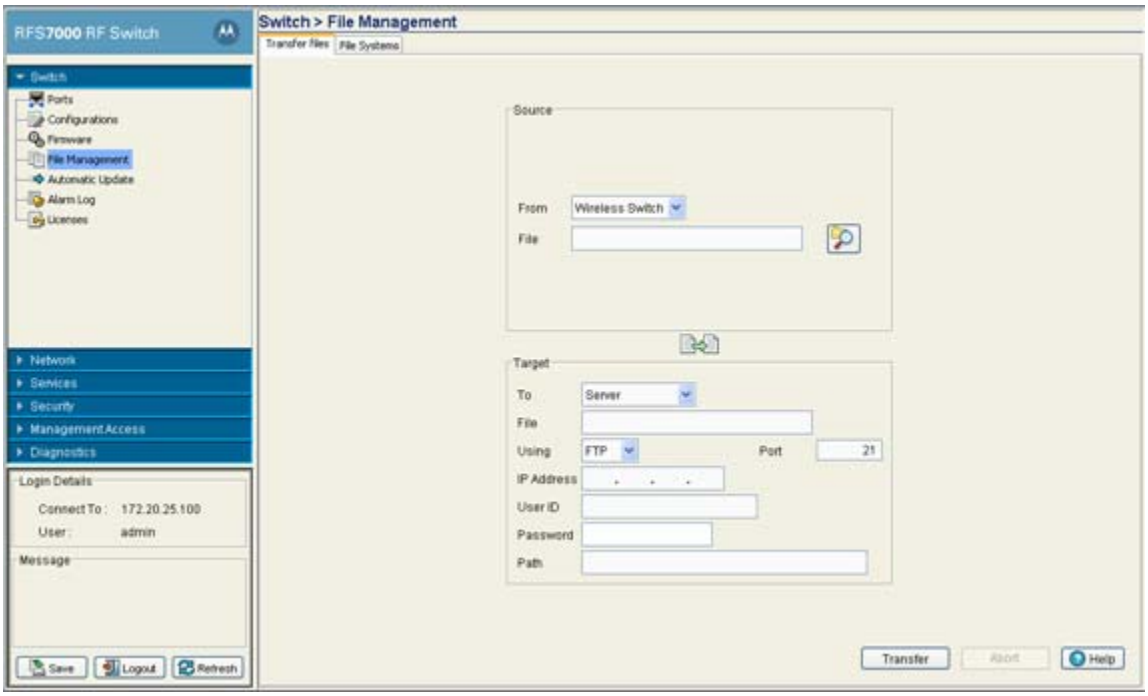
3.5.1 Transferring Files

Use the **Transfer Files** tab to transfer files to and from the switch. Transferring files is recommended to keep files in a secure location. The following file transfer options are available:

- *Wireless Switch to Wireless Switch*
- *Wireless Switch to Server*
- *Server to Wireless Switch*

To define the properties of the file transfer configuration:

1. Select **Switch** > **File Management** from the main menu tree.



2. Refer to the **Source** field to specify the details of the source file.

From	Use the **From** drop-down menu to select the source file's current location. The options include Wireless Switch and Server. The following transfer options are possible: • *Wireless Switch to Wireless Switch* • *Wireless Switch to Server* • *Server to Wireless Switch.* The parameters displayed in the Source and Target fields differ based on the above selection. These different kinds of file transfer techniques are described in the sections that follow.
File	Use the **Browse** button to navigate to a target file for transfer. If the switch is selected from the From drop-down menu (within the Source field), the file used at startup automatically displays.

3.5.1.1 Transferring a file from Wireless Switch to Wireless Switch

To transfer a file from one switch to another:

1. Select **Wireless Switch** from the **From** drop-down menu.

2. Use the **Browse** button to locate a target file for the file transfer.
3. Use the **To** drop-down menu (within the **Target** field) and select **Wireless Switch.** This defines the location of the file.
4. Use the **Browse** button to define a location for the transferred file.
5. Click the **Transfer** button to complete the file transfer.

   The **Message** section in the main menu area displays the file transfer message.
6. Click **Abort** at any time during the transfer process to abort the file transfer.

3.5.1.2 Transferring a file from a Wireless Switch to a Server

To transfer a file from the switch to a Server:

1. Refer to the **Source** field to specify the source file. Use the **From** drop-down menu and select Wireless Switch.
2. Use the **Browse** button and select a file for transfer.

3. Use the **To** drop-down menu (within the Target field) and select Server. This defines the transfer location of the configuration file. Enter the file location marked to store the transferred file.
4. Use the **Using** drop down-menu to configure whether the log file transfer is conducted using FTP, TFTP, HTTP or SFTP. This field display the default port for FTP,TFTP, HTTP or SFTP. The value in this field can be configured as required. Enter the IP Address of the server receiving the source configuration. Ensure the IP address is valid or risk jeopardizing the success of the file transfer. Enter the User ID credentials required to transfer the configuration file from a FTP server.
5. Enter the **Password** required to send the configuration file from an FTP server.
6. Specify the appropriate **Path** name to the target directory on the server. The target options are different depending on the target selected.
7. Click the **Transfer** button to complete the file transfer. The **Message** section in the main menu area displays the file transfer message.
8. Click **Abort** at any time during the transfer process to abort the file transfer.

3.5.1.3 Transferring a file from a Server to a Wireless Switch

To transfer a file from a Server to the switch:

1. Refer to the **Source** field to specify the details of the source file. Use the **From** drop-down menu and select **Server**.

2. Provide the name of the **File**.
3. Use the **Using** drop-down menu to configure whether the file transfer is conducted using FTP, TFTP or HTTP.

   FTP transfers require a valid user ID and password.
4. Enter an **IP Address** of the server receiving the configuration file. Ensure the IP address is valid or risk jeopardizing the success of the file transfer.
5. Enter the **User ID** credentials required to transfer the configuration file from a FTP server.
6. Enter the **Password** required to send the configuration file from an FTP server.
7. Specify the appropriate **Path** name to the target directory on the server. The Target options are different depending on the target selected.
8. Use the **To** drop-down menu (within the Target field) and select Wireless Switch.
9. Use the **Browse** button to browse and select the location to store the file marked for transfer.
10. Click the **Transfer** button to complete the file transfer. The **Message** section displays the status of the file transfer message.
11. Click **Abort** button any time during the transfer process to abort the file transfer.

3.5.2 Viewing Files

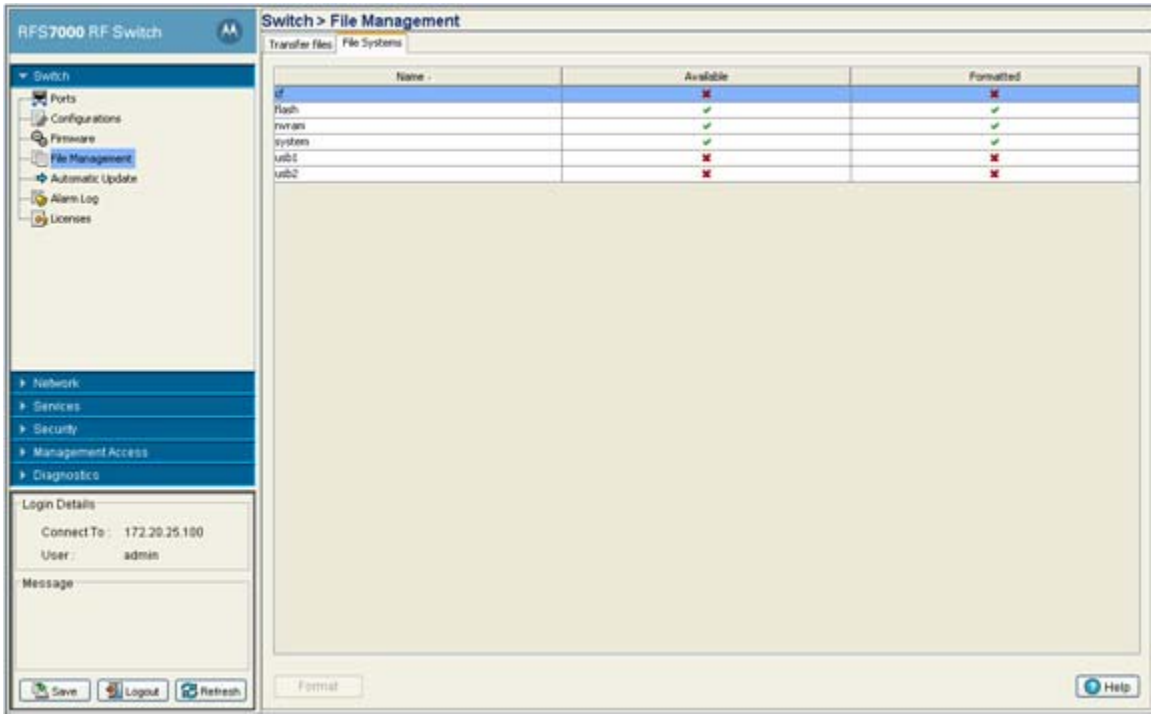
Use the **File System** tab to review the files available to the switch. The switch maintains the following file types:

- *flash*
- *nvram*
- *system*
- *Compact Flash*
- *USB 1*
- *USB 2*

Transfer files between the switch and the server from any one of the above mentioned locations. Since *compact flash* (CF) and USB are external memory locations, the File System window displays the status of these devices. Transfer files to compact flash and USB only if they are connected and available.

To view the file systems currently available to the switch:

1. Select **Switch** > **File Management** from the main menu tree.
2. Select the **File System** tab.



3. Refer to the following **File Systems** information.

Name	Displays the memory locations available to the switch.
Available	Displays the current status of the memory resource. By default, nvram and system are always available. • A green check indicates the device is currently connected to the switch and is available. • A red X indicates the device is currently not available.

Formatted This displays the format status of the memory devices. This ensures that the external and internal memory device store the files securely. A formatted memory device is less prone to crash and loss of data.

- A green tick mark indicates the device is currently connected to the switch and is available.
- A red cross mark indicates the device is currently not available.

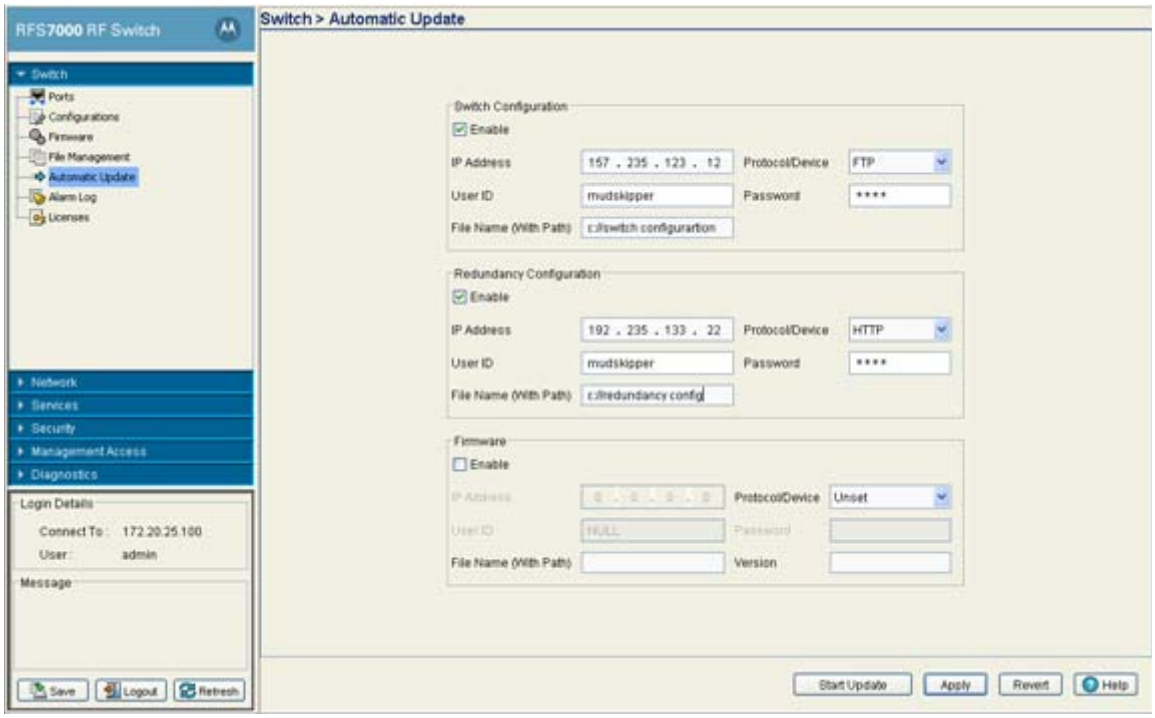
4. Select CF, USB1 or USB2 and click the **Format** button (enabled only if the CF or USB are connected to the switch) to check if the memory device is formatted and available. You will be prompted that proceeding will erase all data on the disk and if you would like to proceed.

3.6 Configuring Automatic Updates

Use the **Automatic Updates** screen to enable a facility that will poll a server address (you designate) when the switch is booted. If updates are found since the last time the switch was booted, the updated version is uploaded to the switch the next time the switch is booted. Enable this option for either the firmware, configuration file or cluster configuration file. Motorola recommends leaving this setting disabled if a review of a new file is required before it is automatically uploaded by the switch.

To enable and configure the automatic update feature for switch firmware, configuration files and cluster configurations:

1. Select **Switch** > **Automatic Update** from the main menu tree.



2. Refer to the **Switch Configuration** field to enable and define the configuration for automatic configuration file updates. If enabled, the located (updated) configuration file will be used with the switch the next time the switch boots

Enable	Select the **Enable** checkbox to allow an automatic configuration file update when a newer (updated) file is detected (upon the boot of the switch) at the specified IP address.
IP Address	Define the **IP address** of the server where the configuration files reside. If a new version is detected when the switch is booted, it is uploaded to the switch and used upon the next boot of the switch.
User ID	Enter the **User ID** required to access the FTP or HTTP server.
Password	Enter the **Password** for the **User ID** required to access the FTP or HTTP server.
File Name (With Path)	Provide the complete and accurate path to the location of the configuration files on the server. This path must be accurate to ensure the most recent file is retrieved.
Protocol/Device	Use the **Protocol** drop-down menu to specify the **Unset**, **FTP, TFTP, HTTP, FLASH**, **CF, USB1, or USB2** as the medium used for the file update from the server. The switch's resident flash is selected by default.
Password	Enter the password required to access the server.

3. Refer to the **Redundancy Configuration** field to enable and define the configuration for automatic cluster file updates.

Enable	Select the **Enable** checkbox to allow an automatic cluster file update when a new (updated) file is detected (upon the boot of the switch) at the specified IP address.
IP Address	Define the **IP address** of the server where the cluster files reside. If a new version is detected when the switch is booted it will be uploaded to the switch and used upon the next boot of the switch.
User ID	Enter the **User ID** required to access the FTP or HTTP server.
Password	Enter the **Password** for the **User ID** required to access the FTP or HTTP server.
File Name (With Path)	Provide the complete and accurate path to the location of the cluster files on the server. This path must be accurate to ensure the most recent file is retrieved.
Protocol/Device	Use the **Protocol** drop-down menu to specify **Unset**, **FTP, TFTP, HTTP, FLASH**, **CF, USB1, or USB2** as the medium used for the file update from the server. The switch's resident flash is selected by default.
Password	Enter the password required to access the server.

4. Refer to the **Firmware** field to enable and define the configuration for automatic firmware updates. If enabled, the located (updated) switch firmware is used with the switch the next time the switch boots.

Enable	Select the **Enable** checkbox to allow an automatic firmware update when a new (updated) version is detected (upon the boot of the switch) at the specified IP address.
IP Address	Define the **IP address** of the server where the firmware files reside. If a new version is detected when the switch is booted, it is uploaded to the switch and used upon the next boot of the switch.
User ID	Enter the **User ID** required to access the FTP or HTTP server.
Password	Enter the **Password** for the **User ID** required to access the FTP or HTTP server.
File Name (With Path)	Provide the complete and accurate path to the location of the firmware files on the server. This path must be accurate to ensure the file is retrieved.
Protocol/Device	Use the **Protocol** drop-down menu to specify **Unset**, **FTP, TFTP, HTTP, FLASH**, **CF, USB1, or USB2** as the medium used for the file update from the server. Unset is selected by default.
Password	Enter the password required to access the server.
Version	Provide the target firmware version to ensure the switch is upgrading to the intended baseline.

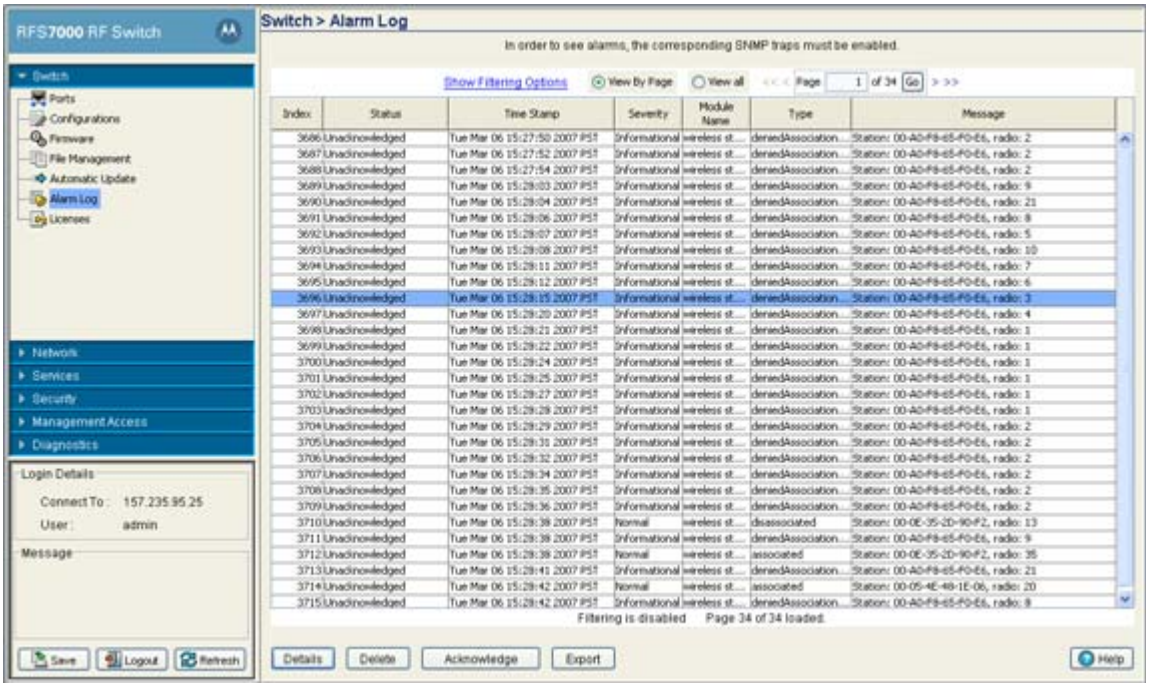
5. Select the **Start Update** button to begin the file updates for the enabled switch configuration, cluster configuration or firmware facilities.
6. Click the **Apply** button to save the changes to the configuration.
7. Click the **Revert** button to revert back to the last saved configuration.

3.7 Viewing the Switch Alarm Log

Use the **Alarm Log** screen as an initial snapshot for alarm log information. Expand alarms (as needed) for greater detail, delete alarms, acknowledge alarms or export alarm data to a user-specified location for archive and network performance analysis.

To view switch alarm log information:

1. Select **Switch** > **Alarm Log** from the main menu tree.



2. Select either of the two available filter options to view alarm log information:

View By Page	Select the **View By Page** radio button to view alarm log information on a per page basis. Use the View By Page option to display alarm logs in pages. If there are a large number of alarms, the user can navigate to the page that has been completely loaded. All operations can be performed on the currently loaded data. Enter a page number next to "Page" and click the **Go** button to move to the specific page.
View All	Select the **View All** radio button to display the complete alarm log with in the table. If there are a large number of alarms, the View All option will take several minutes to load.

3. Refer to the table within the **Alarm Log** screen for the following information:

Index	Displays the unique numerical identifier for trap events (alarms) generated in the system. Use the index to help differentiate an alarm from others with similar attributes.
Status	Displays the unacknowledged or acknowledged state of each alarm.
Time Stamp	Displays the date, year and time the alarm was raised (as well as the time zone of the system). The time stamp only states the time the alarm was generated, not the time it was acknowledged.

Severity	Displays the severity level of the event. Use this (non numerical and verbal) description to assess the criticality of the alarms. Severity levels include: • *Critical* • *Major* • *Warning* • *Informational* • *Normal*
Module Name	Displays the module name that triggered this alarm. Use this information to assess if this alarm is a recurring problem with or if it is an isolated incident.
Type	Displays the alarm type.
Message	Displays a detailed event message corresponding to the alarm event. It contains an event specific message for information about the alarm. Use this value along with the Details description for optimal problem event identification.

4. Select an alarm and click the **Details** button to display an alarm description along with a system proposed solution and possible causes. For more information, see *Viewing Alarm Log Details on page 3-34*.
5. Select the alarm(s) from those listed and click the **Delete** button to remove them from the list of alarms.

   This is not recommended in instances where the problem is unacknowledged and the criticality has not yet been assessed.
6. Select the unacknowledged alarm(s) from those listed and click the **Acknowledge** button to acknowledge them.
7. Click the **Export** button to export the content of the table to a *Comma Separated Values* file (CSV).

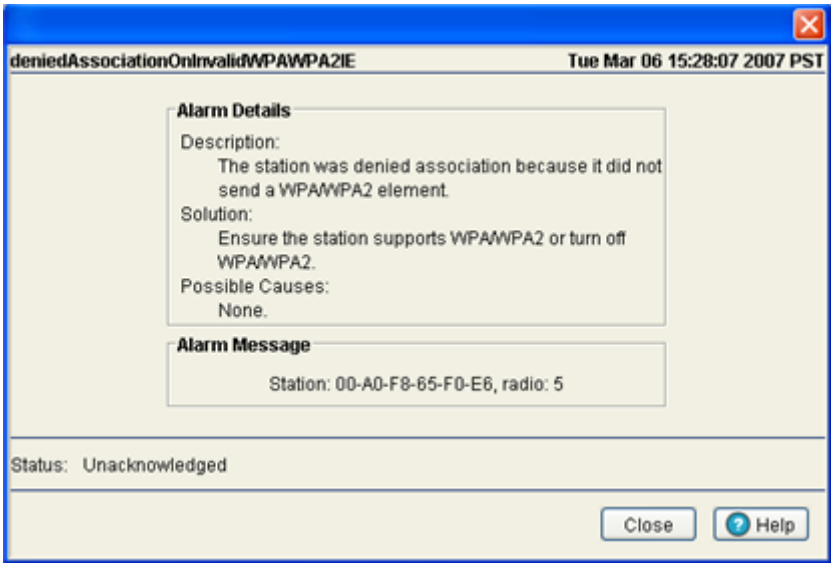
3.7.1 Viewing Alarm Log Details

Use the **Details** option when additional information is required for a specific alarm to make an informed decision on whether to delete, acknowledge or export the alarm.

To review switch alarm details:

1. Select **Switch** > **Alarm Log** from the main menu tree.

2. Select an alarm and click the **Details** button.



3. Refer to the **Alarm Details** and **Alarm Message** for the following information:

Description	Displays the details of the alarm log event. This information can be used in conjunction with the **Solution** and **Possible Causes** items to troubleshoot the event and determine how the event can be avoided in the future.
Solution	Displays a possible solution to the alarm event. The solution should be attempted first to rectify the described problem.
Possible Causes	Describes the probable causes that could have raised this specific alarm. Determine whether the causes listed can be remedied to avoid this alarm from being raised in the future.
Alarm Message	Displays the radio (and MAC address if relevant) reporting the alarm detail information.

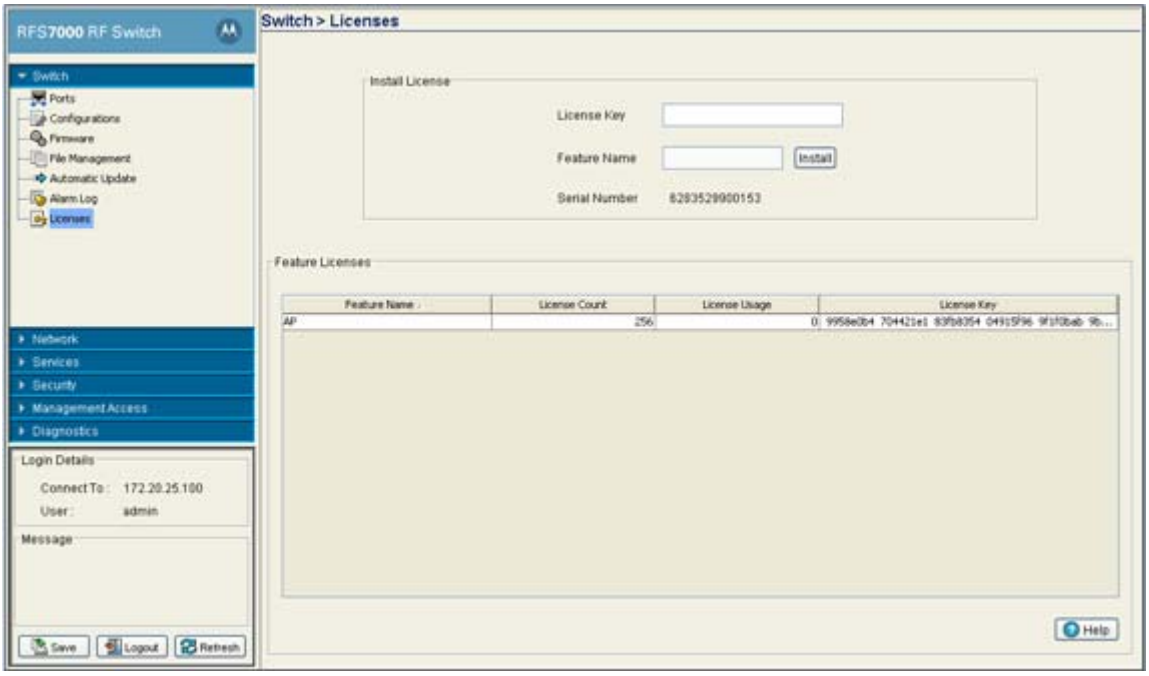
4. Click **Close** to exit the dialog.

3.8 Viewing Switch Licenses

Use the **Licenses** screen to install and add a new licenses on the switch.

To install a new license:

1. Select **Switch** > **Licenses** from the main menu tree.



2. Refer to the **Install License** field for the following information:

License Key	Enter the license key required to install a particular feature. The license key is provided when you supply the switch serial number to Motorola support.
Feature Name	Enter the name of the feature you wish to install/upgrade using the license.
Serial Number	Displays the serial number of the switch used for generating the license key.

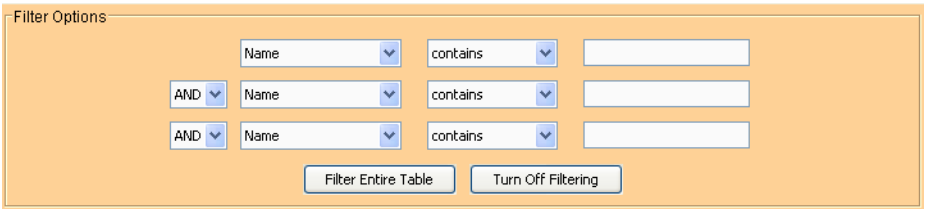
3. Click the **Install** button to install the selected license.
4. Refer to the **Feature Licenses** table for the following license specific information:

Feature Name	Displays the name of the feature either installed or upgraded on the switch.
License Count	The number of licenses applied while entering the license key.
License Usage	The number of licenses currently in use. Determine whether this number adequately represents the number of switches you need to deploy.
License Key	The license key for the feature installed/upgraded.

3.9 How to use the Filter Option

Use the Filter Option to sort the display details of screen that employ the filtering option as a means of sorting how data is displayed within the screen.

1. Click the **Show Filtering Option** to expand the Filter Option zone, whenever it appears in any screen.



2. Enter the filter criteria as per the options provided in the Filter Option zone.
3. The fields in the Filter Option zone are populated with the parameters of the screen in which it appears.

   Filtering is always conducted for the entire table.
4. Click the **Filter Entire Table** button to filter the entire table in which the filter zone appears.

   The result of the filtering operation displays at the bottom of the table
5. Click the **Turn Off Filtering** button to disable the filtering option for the screen where it appears.

   Filtering status (when filtering is turned off) displays at the bottom of the table.
6. Click the **Hide Filtering Option** button to hide the Filter Option zone.

4

Network Setup

This chapter describes the Network Setup menu information used to configure the switch. This chapter consists of the following switch Network configuration activities:

- *Displaying the Network Interface*
- *Viewing Network IP Information*
- *Viewing and Configuring Layer 2 Virtual LANs*
- *Configuring Switch Virtual Interfaces*
- *Viewing and Configuring Switch WLANs*
- *Viewing Associated MUs*
- *Viewing Access Port Radio Information*
- *Viewing Access Port Adoption Defaults*
- *Viewing Access Port Status*
- *Multiple Spanning Tree*

NOTE HTTPS must be enabled to access the switch applet. Ensure HTTPS access has been enabled before using the login screen to access the switch applet.

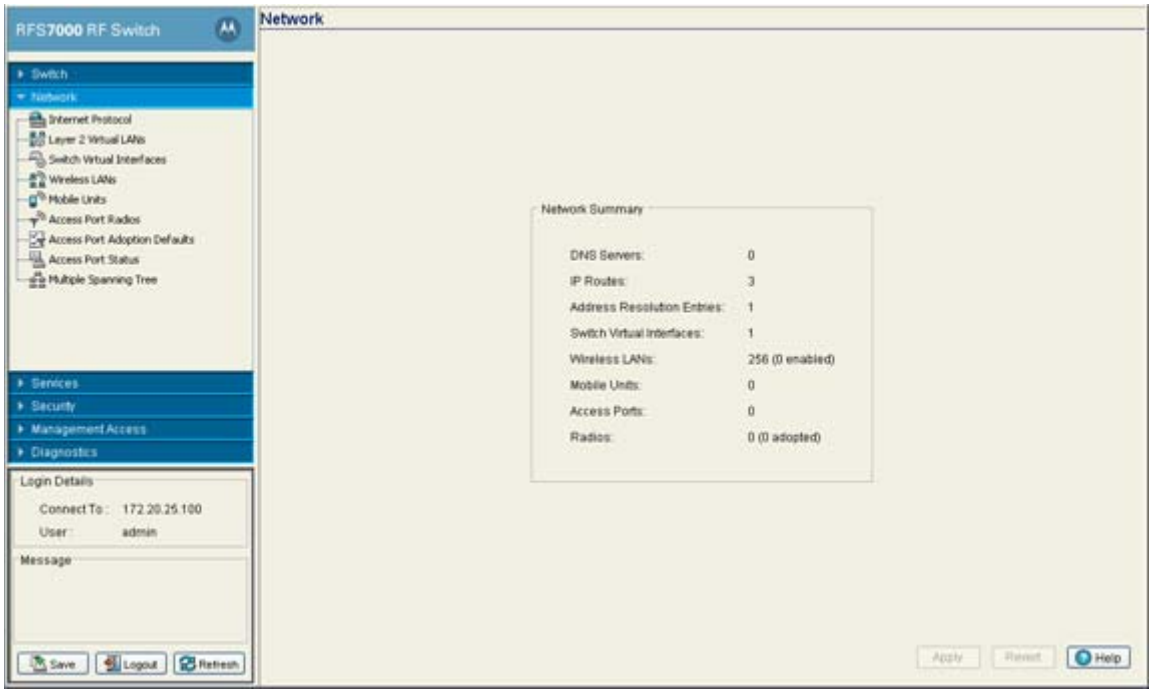
4.1 Displaying the Network Interface

The main **Network** interface displays a high-level overview of the configuration (default or otherwise) as defined within the Network main menu. Use the information to determine if items require additional configuration using the sub-menu items under the main Network menu item.

NOTE When the switch's configuration is successfully updated (using the Web UI), the effected screen is closed without informing the user their change was successful. However, if an error were to occur, the error displays within the effected screen's Status field and the screen remains displayed. In the case of file transfer operations, the transfer screen remains open during the transfer operation and remains open upon completion (with status displayed within the Status field).

To view the switch's Network configuration:

1. Select **Network** from the main menu tree.



2. Refer to the following information to discern if configuration changes are warranted:

DNS Servers	Displays the number of DNS Servers configured thus far for use with the switch. For more information, see *Viewing Network IP Information on page 4-4*.
IP Routes	Displays the number of IP routes for routing packets to a defined destination. For information on defining IP Routes, see *Configuring IP Forwarding on page 4-6*.
Address Resolution Entries	Displays the number of layer three (IP) address to layer two (MAC) address mappings. For more information, see *Viewing Address Resolution on page 4-8*.
Switch Virtual Interfaces	Displays the number of virtual interfaces (VLANs) defined thus far for the switch. New VLANs can be defined or existing VLANs can be modified as needed. For more information, see *Configuring Switch Virtual Interfaces on page 4-13*.
Wireless LANs	Displays the number of WLANs currently defined on the switch. The switch has 256 default WLANs. New WLANs can be added as needed, and their descriptions, VLAN assignments and security schemes modified. For more information, see *Viewing and Configuring Switch WLANs on page 4-23*.
Mobile Units	Displays the number of MUs currently associated to (and interacting with) the switch. The details of individual MUs can be displayed as needed. For more information, see *Viewing Associated MUs on page 4-76*.
Access Ports	Displays the number of *Access Ports* (APs) active on the switch. Access ports can be added or existing APs can have their VLAN assignments changed, their descriptions modified and their current authentication and encryption schemes modified. For more information, see *Viewing Access Port Radio Information on page 4-84*.
Radios	Displays the number of AP radios detected over the switch managed network. Displayed with this information is the number of radios detected that have been adopted by the switch. For more information, see *Viewing Access Port Status on page 4-117*.

The **Apply** and **Cancel** buttons are greyed out within this screen, as there is no data to be configured or saved.

4.2 Viewing Network IP Information

Use the **Internet Protocol** screen to view and configure network associated IP details. The Internet Protocol screen contains tabs supporting the following configuration activities:

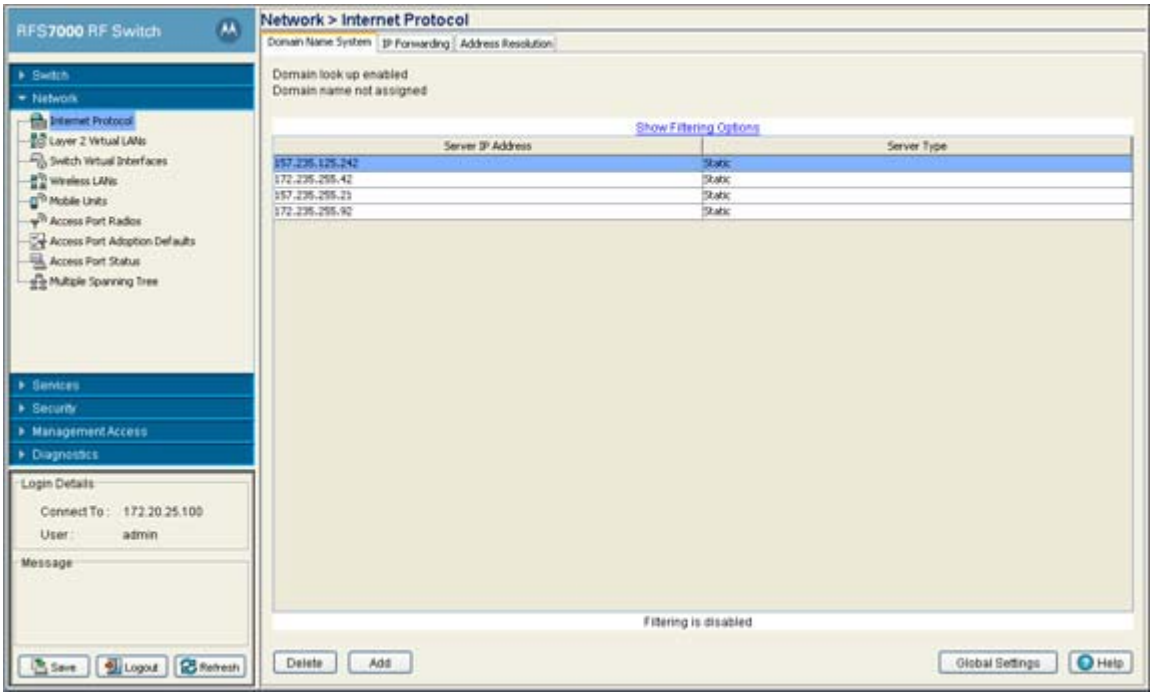
- *Configuring DNS*
- *Configuring IP Forwarding*
- *Viewing Address Resolution*

4.2.1 Configuring DNS

Use the **Domain Name System** tab to view Server address information and delete or add severs to the list of servers available. To configure DNS:

1. Select **Network > Internet Protocol** from the main tree menu.
2. Select the **Domain Network System** tab (displayed by default).

   Use the Show Filtering Options link to view the details displayed in the table.



3. The **Domain Name System** tab displays DNS details in a tabular format.

Server IP Address	Displays the IP address of the domain name server(s) the system can use for resolving domain names to IP addresses. Domain look up order is determined by the order of the servers listed. The first server queried is the first server displayed. Therefore, ensure obsolete addresses are periodically removed.
Server Type	Displays whether the DNS IP address entry has been created statically (manually) or dynamically. The DHCP server provides the dynamic DNS IP address entry displayed on the list. A static DNS IP address can be created by clicking the **Add** button.

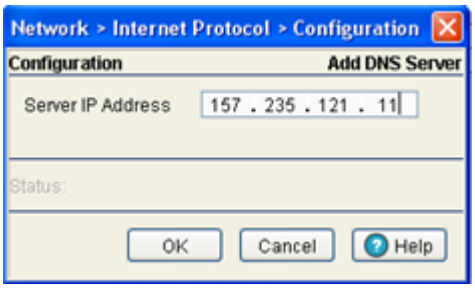
4. Select an IP Address from the table and click the **Delete** button to remove the selected entry from the list.
5. Click the **Add** button to display a screen used to add another domain name server. For more information, see *Adding an IP Address for a DNS Server on page 4-5*.
6. Click the **Global Settings** button to open a screen that allows domain lookup to be enabled/disabled and the domain name specified. For more information, see *Configuring Global Settings on page 4-5*.

4.2.1.1 Adding an IP Address for a DNS Server

Add an IP address for a new domain server using the **Add** screen.

1. Click the **Add** button within the Domain Network System screen.

   The new **Configuration** screen displays enabling you to add IP address for the DNS Server.



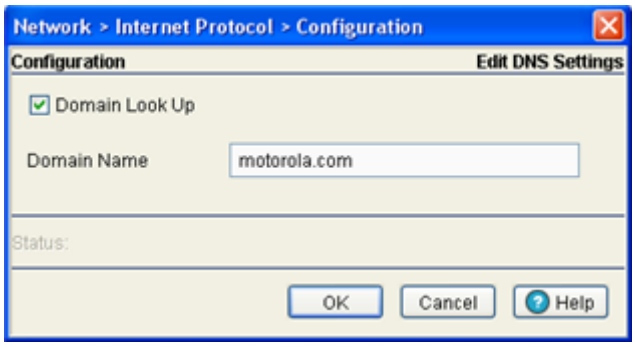
2. Enter the **Server IP Address** to define the IP address of the new static domain name server.
3. Refer to the **Status** field for the current state of the requests made from applet. This field displays error messages if something goes wrong in the transaction between the applet and the switch.
4. Click **OK** to use the changes to the running configuration and close the dialog.
5. Click **Cancel** to close the dialog without committing updates to the running configuration.

4.2.1.2 Configuring Global Settings

Use the **Global Settings** screen to query domain name servers to resolve domain names to IP addresses. Use this screen to enable/disable **Domain look up**, which allows you to use commands like ping, traceroute etc. using hostnames rather than IP addresses.

1. Click the **Global Settings** button in the main Domain Network System screen.

   A **Configuration** screen displays for editing the DNS settings of the server.



2. Select the **Domain Look Up** checkbox to enable the switch to query domain name servers to resolve domain names to IP addresses.

NOTE The look up order is determined by the order of the servers within **Domain Name System** tab. The first server queried is the first server displayed.

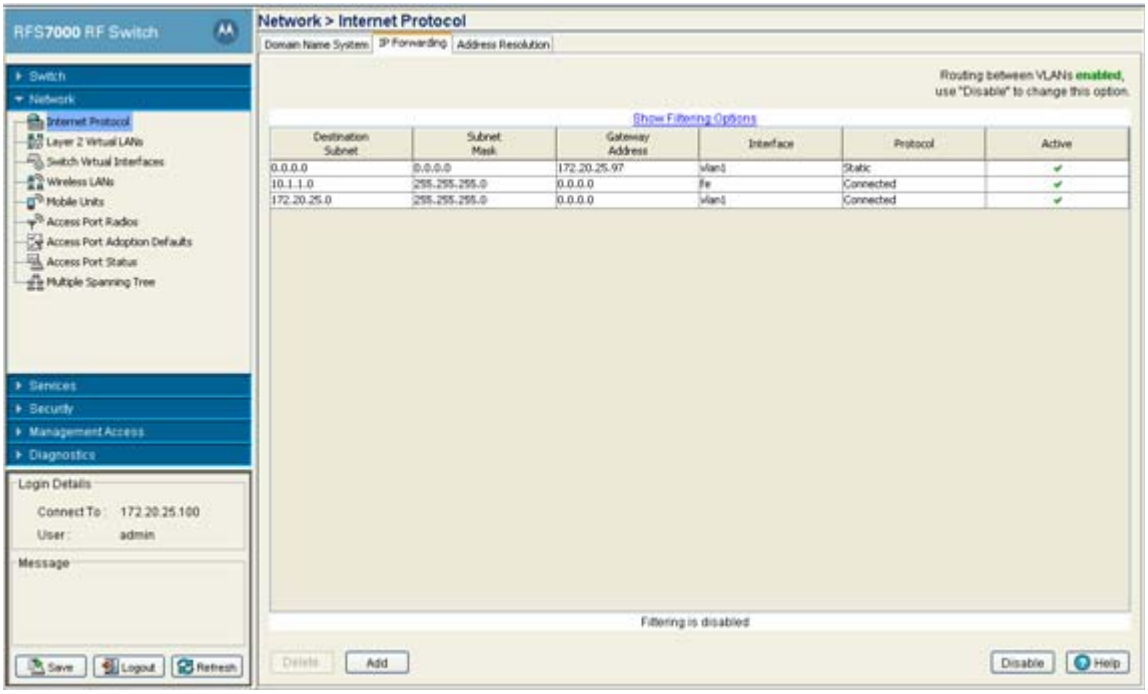
3. Enter a **Domain Name** in the text field. This is the switch's domain.
4. Refer to the **Status** field for the current state of the requests made from applet. This field displays error messages if something goes wrong with the transaction between the applet and the switch.
5. Click **OK** to use the changes to the running configuration and close the dialog.
6. Click **Cancel** to close the dialog without committing updates to the running configuration.

4.2.2 Configuring IP Forwarding

The IP Forwarding table lists all the routing entries to route packets to a specific destination. To view the IP forwarding details:

1. Select **Network** > **Internet Protocol** from the main tree menu.
2. Select the **IP Forwarding** tab.

   Use the Filtering Option to view the details displayed in the table.



3. The read-only **IP Forwarding** tab displays the current status between VLANs. To toggle the status between VLANs, use the **Enable/Disable** options located at the bottom of the screen.

   The following details display in the table:

   Destination Subnet — Displays the mask used for destination subnet entries. The Subnet Mask is the IP used to divide internet addresses into blocks (known as subnets). A value of 255.255.255.0 will support 256 IP addresses.

Subnet Mask	Displays the mask used for destination subnet entries. The Subnet Mask is the IP mask used to divide internet addresses into blocks (known as subnets). A value of 255.255.255.0 will support 256 IP addresses.
Gateway Address	Displays the IP address of the Gateway used to route the packets to the specified destination subnet. Do not set the gateway address to any VLAN interface used by the switch.
Interface	Displays the interface name to which destination subnet entries are attached.
Protocol	Displays the name of the routing protocol with which this route was obtained. Possible values are: • *Static* — Routes are statically added by the operator. • *DHCP* — Routes that are obtained from the DHCP server. • *Connected* — Routes automatically installed by the switch for directly connected networks based on interface IP addresses. • *Kernel/ICMP* — Routes added as a result of receiving an ICMP redirect from an intermediate router.
Active	When IP Forwarding is enabled for the selected subnet, a green check displays in the Active column. A red X defines the subnet as disabled.

4. Select an entry and click the **Delete** button to remove the selected entry from the IP forwarding table.
5. Click the **Add** button to create a new static route. For more information, see *Adding a New Static Route on page 4-7*.
6. Click **Enable** (to allow) or **Disable** (to deny) routing between VLANs.

4.2.2.1 Adding a New Static Route

Use the **Add** screen to add a new destination subnet, subnet mask and gateway for routing packets to a defined destination. Use the screen when an existing destination subnet does not meet the needs of the network. To add a new static route:

1. Click the **Add** button.

   A new **Configuration** screen displays enabling you to add a new destination subnet, subnet mask and gateway for routing packets to a defined destination.

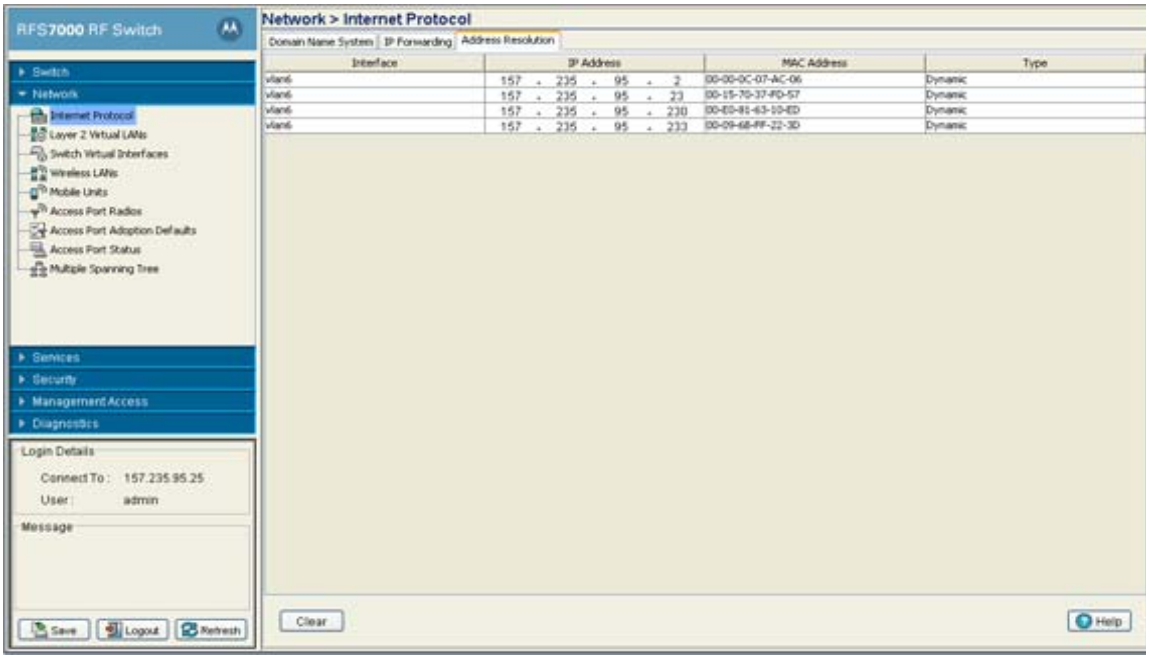
2. In the **Destination Subnet** field, enter an IP address to route packets to a specific destination address.
3. Enter a subnet mask for the destination subnet in the **Subnet Mask** field.

   The Subnet Mask is the IP mask used to divide internet addresses into blocks known as subnets. A value of 255.255.255.0 support 256 IP addresses.
4. In the **Gateway Address** field, enter the IP address of the gateway used to route the packets to the specified destination subnet. Do not set the gateway address to a VLAN interface used by the switch.
5. Refer to the **Status** field for the current state of the requests made from applet. This field displays error messages if something goes wrong in the transaction between the applet and the switch.
6. Click **OK** to use the changes to the running configuration and close the dialog.
7. Click **Cancel** to close the dialog without committing updates to the running configuration.

4.2.3 Viewing Address Resolution

The **Address Resolution** table displays the mapping of layer three (IP) addresses to layer two (MAC) addresses. To view address resolution details:

1. Select **Network** > **Internet Protocol** from the main tree menu.
2. Select the **Address Resolution** tab.



3. Refer to the **Address Resolution** table for the following information:

Interface	Displays the name of the actual interface where the IP address was found (typically a VLAN).
IP Address	Displays the IP address being resolved.
MAC Address	Displays the MAC address corresponding to the IP address being resolved.
Type	Defines whether the entry was added statically or created dynamically in respect to network traffic. Entries are typically static.

4. Click the **Clear** button to remove the selected ARP entry if no longer usable.

4.3 Viewing and Configuring Layer 2 Virtual LANs

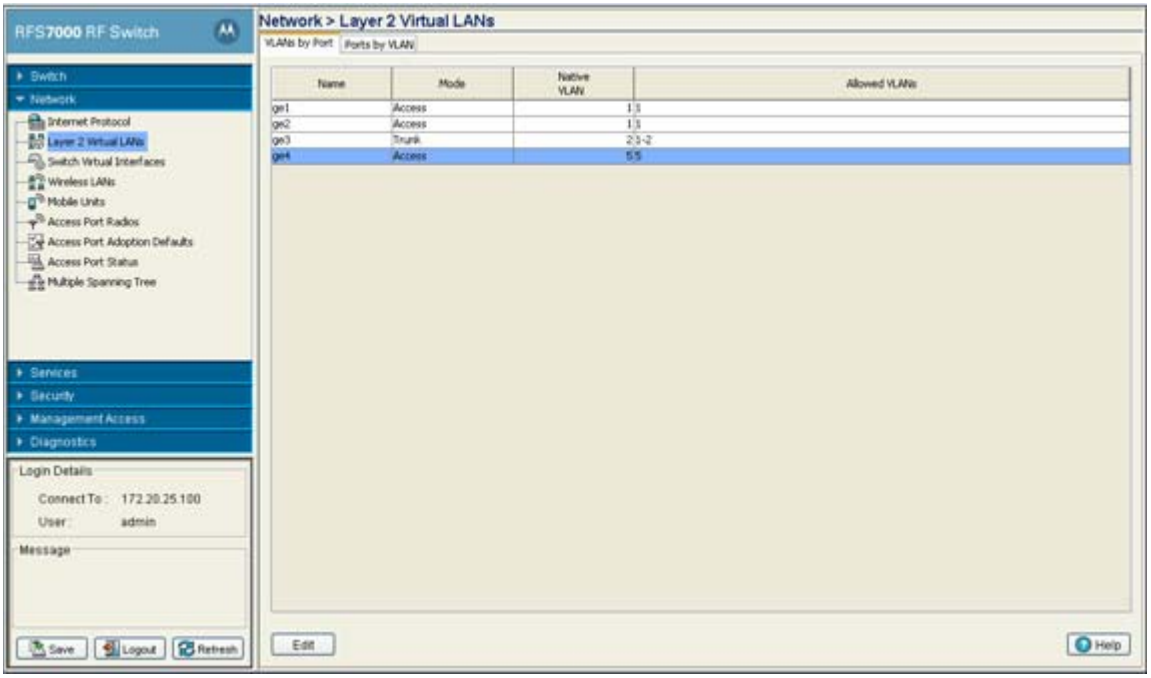
A *virtual LAN* (VLAN) is similar to a *Local Area Network* (LAN), however devices do not need to be connected to the same segment physically. Devices operate as if connected to the same LAN, but could be connected at different physical connections across the LAN segment. The VLAN can be connected at various physical points but react as if it were connected directly. One of the biggest advantages of a VLAN, is when a computer is physically moved to another location, it can stay on the same VLAN without reconfiguration. The switch can support multiple VLANs. Use the Layer 2 Virtual LANs screen to view and configure VLANs by Port and Ports by VLAN information. Refer to the following VLAN configuration activities:

- *Viewing and Configuring VLANs by Port*
- *Viewing and Configuring Ports by VLAN*

4.3.1 Viewing and Configuring VLANs by Port

To view VLAN information by port designation:

1. Select **Network** > **Layer 2 Virtual LANs** from the main menu tree.



Refer to following details within the table:

Name	Displays the name of the VLAN to which the switch is currently connected.

Mode	It can be either Access or Trunk. • *Access*– This ethernet interface accepts packets only form the native VLANs. • *Trunk*–The Ethernet interface allows packets from the given list of VLANs you add to the trunk.
Native VLAN	Displays the tag assigned to the native VLAN.
Allowed VLANs	Displays VLAN tags allowed on this interface.

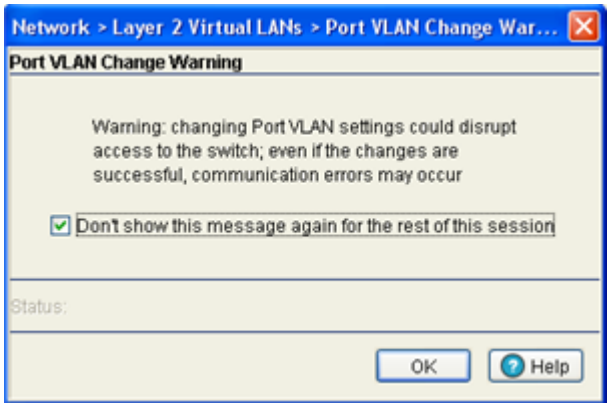
2. Select a record from the table and click the **Edit** button to modify the record. For more information, see *Editing the Details of an Existing VLAN on page 4-10*.

4.3.1.1 Editing the Details of an Existing VLAN

To revise the configuration of an existing VLAN:

1. Select **Network** > **Virtual LANs** from the main menu tree.
2. Select an Ethernet interface and click the **Edit** button.

   The system prompts you with a **Port VLAN Change Warning** message stating communication disruptions could occur with the switch.
3. Click **OK** to continue.


Network > Layer 2 Virtual LANs > Port VLAN Change War...
Port VLAN Change Warning
Warning: changing Port VLAN settings could disrupt access to the switch; even if the changes are successful, communication errors may occur
Don't show this message again for the rest of this session
Status:
OK
Help

4. Use the Edit screen to modify the VLAN's mode, access VLAN and allowed VLAN designation.

5. Use the Edit screen to modify the following:

Name	Displays a read only field with the name of the port to which the VLAN is associated.
Mode	Use the drop-down menu to select the mode. It can be either: • *Access*– This Ethernet interface accepts packets only form the native VLANs. If this mode is selected, the Allowed VLANs field is unavailable. • *Trunk*–The Ethernet interface allows packets from the given list of VLANs you can add to the trunk.
Native VLAN	Use this field to change the tag assigned to native VLAN.
Allowed VLANs	This section has the following 2 options (and is only available when Trunk is selected as the Mode): • *No VLANs*– Select this option if you do not wish to add any additional VLANs. • *Selected VLANs*– Select this option if you wish to add additional VLANs.

6. Refer to the **Status** field for the current state of the requests made from applet. This field displays error messages if something goes wrong in the transaction between the applet and the switch.
7. Click **OK** to use the changes to the running configuration and close the dialog.
8. Click **Cancel** to close the dialog without committing updates to the running configuration.

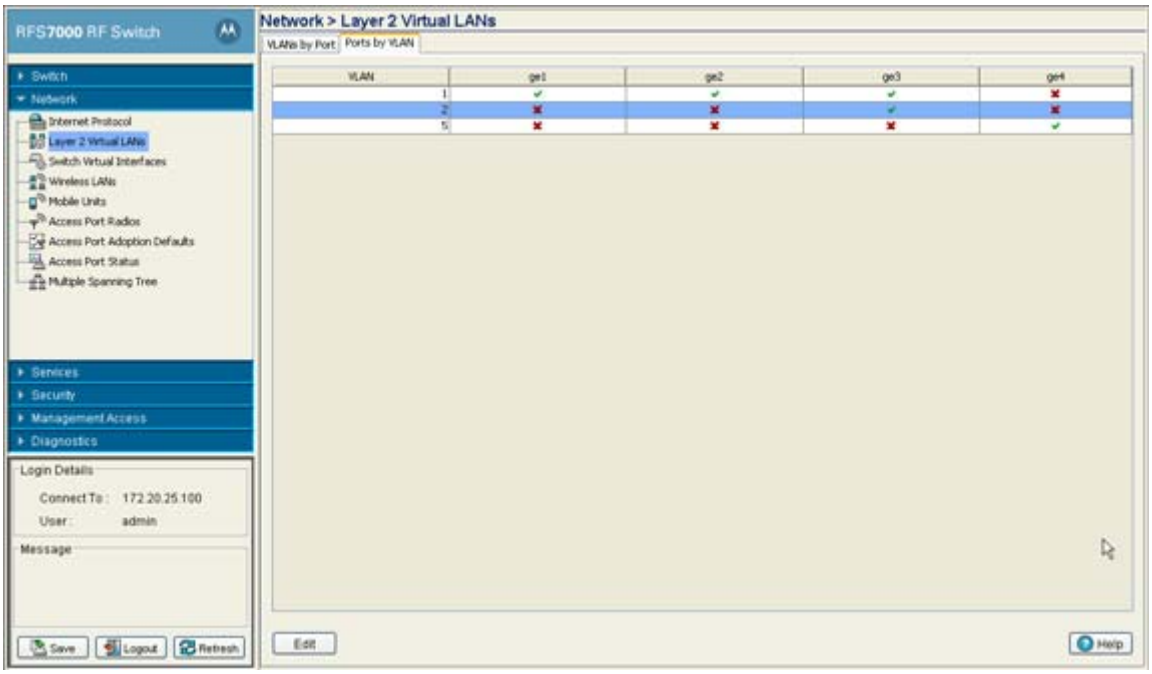
4.3.2 Viewing and Configuring Ports by VLAN

A *Virtual Local Area Network* (VLAN) is a switched network segmented by function or application rather than a traditional LAN segmentation (based on physical location). VLANs allow a greater level of flexibility and enable changes to the network infrastructure without physically disconnecting network equipment.

To view VLAN by Port information:

1. Select **Network** > **Layer 2 Virtual LANs** from the main menu tree.
2. Select the **Ports by VLAN** tab.

VLAN details display within the **VLANs by Port** tab.



3. Refer to the following information as displayed within the VLANs by Port tab:

VLAN	Displays the name of each VLAN configured on the switch.
ge#	The VLAN and **ge** columns display the VLAN association status of each VLAN on the switch. If a VLAN is associated with a ge port, the column displays a green checkmark. If the ge port is not associated with the VLAN, the column displays a red X mark.

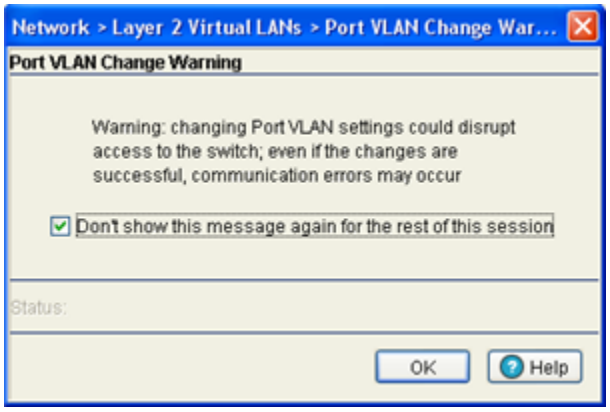
4. Select an Ethernet port and click the **Edit** button to revise the current mapping. For more information on editing VLAN by Port assignments and designations, see *Editing a VLAN by Port Designation on page 4-12*.

4.3.2.1 Editing a VLAN by Port Designation

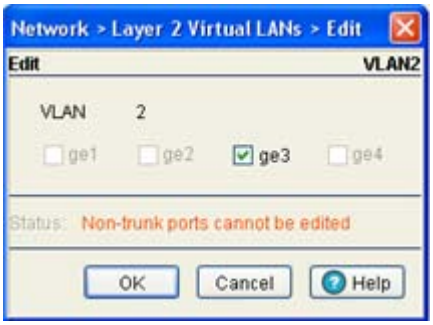
Use the VLAN by Ports Edit facility to modify the port designations available for the selected VLAN. To edit existing VLAN by Port information:

1. Select **Network** > **Layer 2 Virtual LANs** from the main menu tree.
2. Select the **Ports by VLAN** tab.

3. Highlight an existing VLAN and click the **Edit** button. The system displays a Port VLAN Change Warning message. Be advised, changing VLAN designations could disrupt access to the switch.


Network > Layer 2 Virtual LANs > Port VLAN Change War...
Port VLAN Change Warning
Warning: changing Port VLAN settings could disrupt access to the switch; even if the changes are successful, communication errors may occur
Don't show this message again for the rest of this session
Status:
OK
Help

4. Click **OK** to continue. A new window displays wherein the VLAN assignments can be modified for the selected VLAN.



5. Change VLAN port designations as required.

VLAN	Displays a read-only field and with the name of the VLAN selected.
ge#	Displays the ge ports on the switch. To associate a port with the VLAN, check the box next to it. To unassociate the port or security associator from the VLAN, uncheck the box. Non-trunked ports cannot be edited, and are greyed out.

6. Click **OK** to use the changes to the running configuration and close the dialog.
7. Click **Cancel** to close the dialog without committing updates to the running configuration.

4.4 Configuring Switch Virtual Interfaces

A *switch virtual interface* (SVI) is required for layer 3 (IP) access to the switch or provide layer 3 service on a VLAN. The SVI defines which IP address is associated with each VLAN ID the switch is connected to. A SVI is created for the default VLAN (VLAN 1) to enable remote switch administration. A SVI is also used to map a VLANs to IP address ranges. This mapping determines the destination networks for switch routing.

Each IP address range (IP Address and Subnet Mask) can be mapped to one (and only one) VLAN ID. A VLAN ID does not require an IP address be defined on the switch. Each VLAN ID must be mapped to a physical port using the Layer 2 Virtual LANs configuration to communicate with the rest of the network.

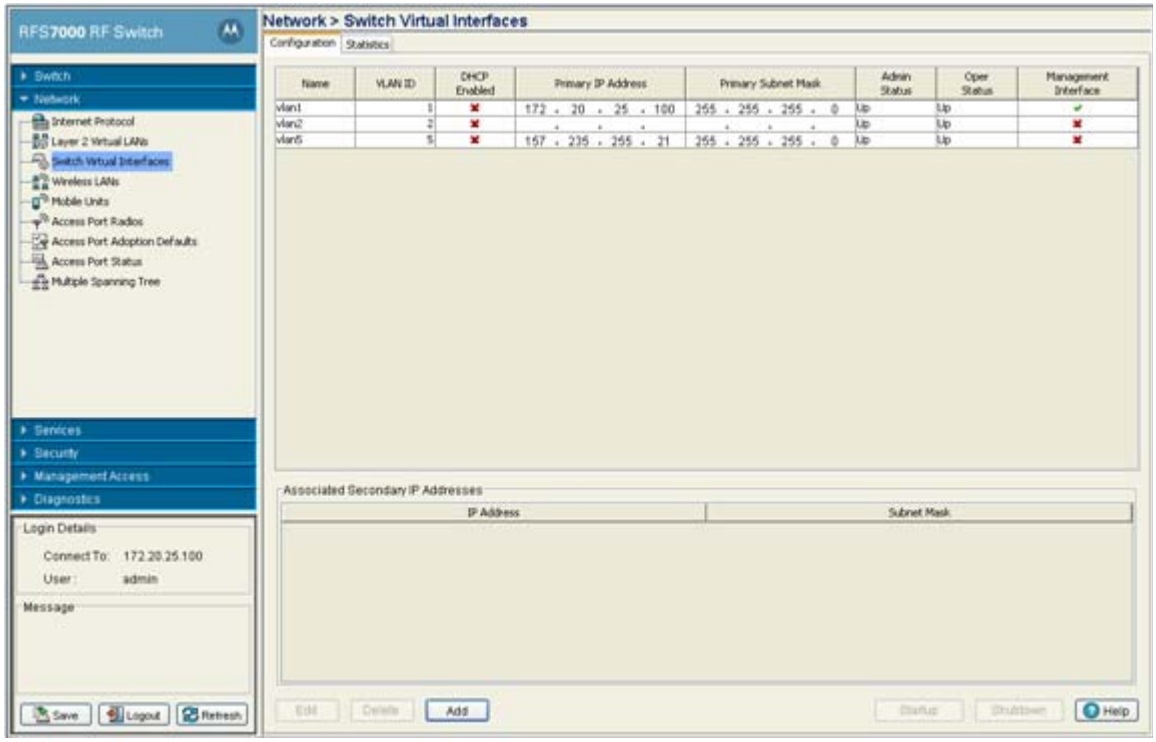
Use the **Switch Virtual Interfaces** screen to view and configure VLAN interfaces. This screen contains two tabs supporting the following activities:

- *Configuring the Virtual Interface*
- *Viewing Virtual Interface Statistics*

4.4.1 Configuring the Virtual Interface

Use the **Configuration** screen to view and configure virtual interface details.

1. Select **Network** > **Switch Virtual Interface** from the main tree menu.
2. Select the **Configuration** tab.



The following configuration details display in the table:

Name	Displays the name of the virtual interface.
VLAN ID	Displays the VLAN ID associated with the interface.
DHCP Enabled	Displays whether the DHCP client is enabled. A green check mark defines the DHCP client as enabled for the interface. A red X means the interface is disabled.
Primary IP Address	Displays the IP address for the virtual interface.
Primary Subnet Mask	Displays the subnet mask assigned for this interface.
Admin Status	Displays whether the virtual interface is operational and available to the switch.
Oper Status	Displays whether the selected Switch Virtual Interface is currently (Up) or not (Down) on the switch.

Management Interface	A green checkmark within this column defines this VLAN as currently used by the switch. This designates the interface settings used for global switch settings in case of conflicts. For example, if multiple SVIs are configured with DHCP enabled on each, the switch could have multiple domain names assigned from different DHCP servers The one assigned over the selected Management Interface would be the only one used by the switch. This setting does not affect any of the Management Access Interfaces configured in *Configuring Access Control on page 7-3*.

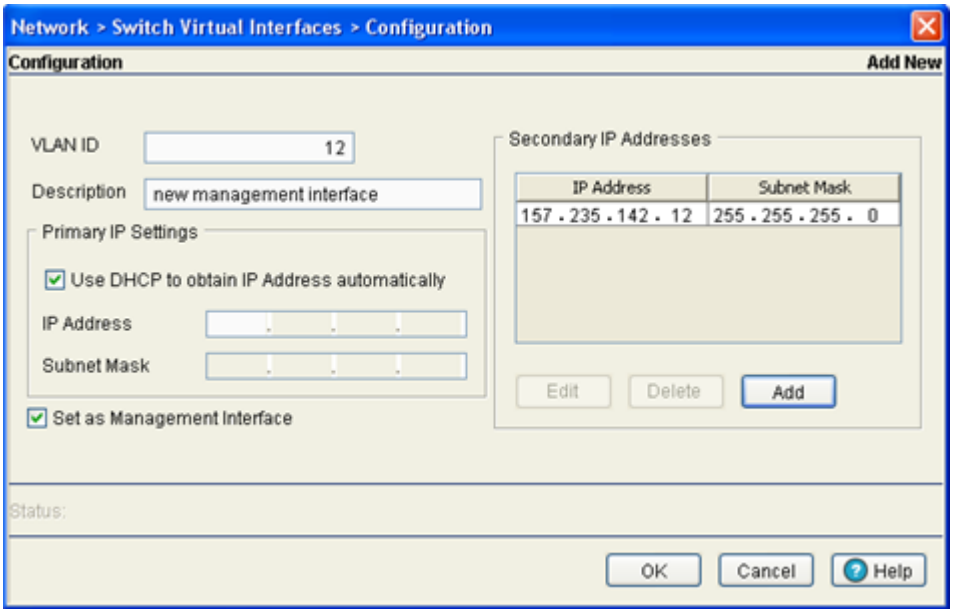
The **Associated Secondary IP Addresses** field displays additional IP and subnet resources available, but designated as secondary and not immediately used unless the primary designations become unavailable.

3. Select a record from the table and click the **Edit** button to modify the record. For more information, see *Modifying a Virtual Interface on page 4-16*.
4. Select a record from the table and click the **Delete** button to remove the configuration from the list of switch virtual interfaces.
5. Click the **Add** button to add a new configuration to the switch virtual interface. For more information, see *Adding a Virtual Interface on page 4-15*.
6. Select an interface as click the **Startup** button to invoke the selected interface the next time the switch is booted.
7. Select an interface as click the **Shutdown** button to disable the selected interface.

4.4.1.1 Adding a Virtual Interface

To add a new virtual interface for the switch:

1. Select **Network** > **Switch Virtual Interface** from the main tree menu.
2. Select the **Configuration** tab
3. Click the **Add** button.



4. Enter the **VLAN ID** for the switch virtual interface.

5. Provide a **Description** for the VLAN, representative of the VLAN's intended operation within the switch managed network.
6. The **Primary IP Settings** field consists of the following:
   a. Select **Use DHCP to obtain IP Address automatically** to allow DHCP to provide the IP address for the virtual interface. Selecting this option disables the IP address field.
   b. Enter the **IP Address** for the VLAN associated virtual interface.
   c. Enter the **Subnet Mask** for the IP address.
7. Select the **Set as Management Interface** checkbox to enable any host displayed in this VLAN to configure the switch.
8. Use the **Secondary IP Addresses** field to define additional IP addresses to associate with VLAN IDs. The address provided in this field is used if the primary IP address is unreachable.

   Select the **Add** button (within the Secondary IP Addresses field) to define additional addresses from a sub screen. Choose an existing secondary address and select **Edit** or **Delete** to revise or remove a secondary address.
9. Refer to the **Status** field for the current state of the requests made from applet. This field displays error messages if something goes wrong in the transaction between the applet and the switch.
10. Click **OK** to use the changes to the running configuration and close the dialog.
11. Click **Cancel** to close the dialog without committing updates to the running configuration.

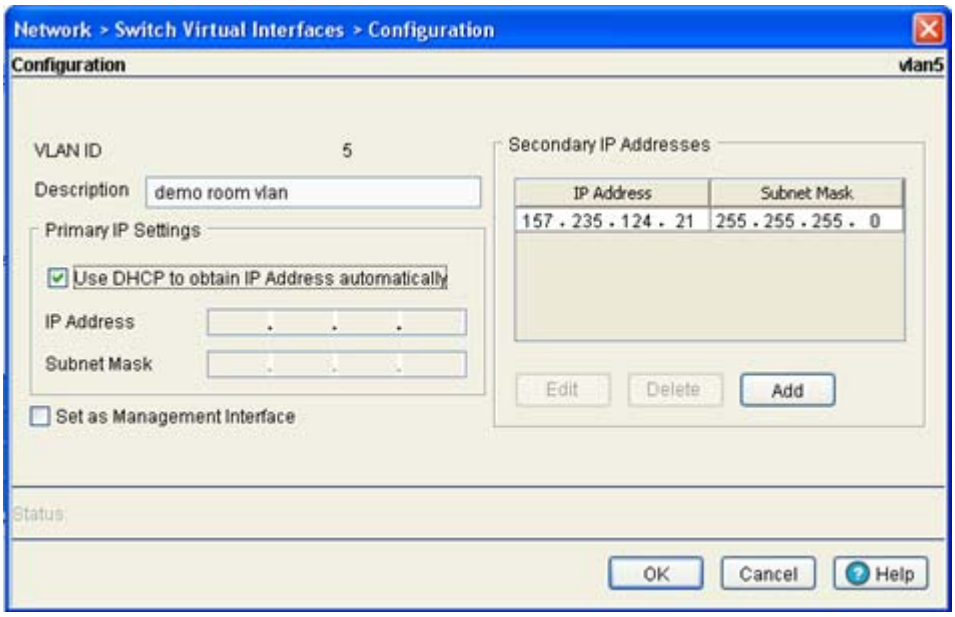
4.4.1.2 Modifying a Virtual Interface

To modify an existing virtual interface.

CAUTION When changing from a default DHCP address to a fixed IP address, set a static route first. This is critical when the switch is being accessed from a subnet not directly connected to the switch and the default route was set using DHCP.

1. Select **Network** > **Switch Virtual Interface** from the main tree menu.

2. Select the **Configuration** tab and click the **Edit** button.



   The screen displays with the name of the VLAN displayed in the upper left-hand side. The VLAN ID cannot be modified and should be used to associate the VLAN ID with the description and IP address assignments defined.

3. If necessary, modify the **Description** of the VLAN, to make it representative of the VLAN's intended operation within the switch managed network.
4. Unselect the **Use DHCP to obtain IP Address automatically** checkbox to assign IP addresses manually and you do not want DHCP to provide them.
5. Use the **Primary IP Address** field to manually enter the IP address for the virtual interface.
6. Enter the **Subnet Mask** for the IP address.
7. Select the **Set as Management Interface** checkbox to convert the selected VLAN ID to a management interface.
8. Use the **Secondary IP Addresses** field to define/modify additional IP addresses to associate with VLAN IDs. The addresses provided will be used if the primary IP address is unreachable.

   Select the **Add** button (within the Secondary IP Addresses field) to define/modify additional addresses from a sub screen. Select an existing secondary address and select **Edit** or **Delete** to revise or remove a secondary address as needed.
9. Refer to the **Status** field for the current state of the requests made from applet. This field displays error messages if something goes wrong in the transaction between the applet and the switch.
10. Click **OK** to use the changes to the running configuration and close the dialog.
11. Click **Cancel** to close the dialog without committing updates to the running configuration.

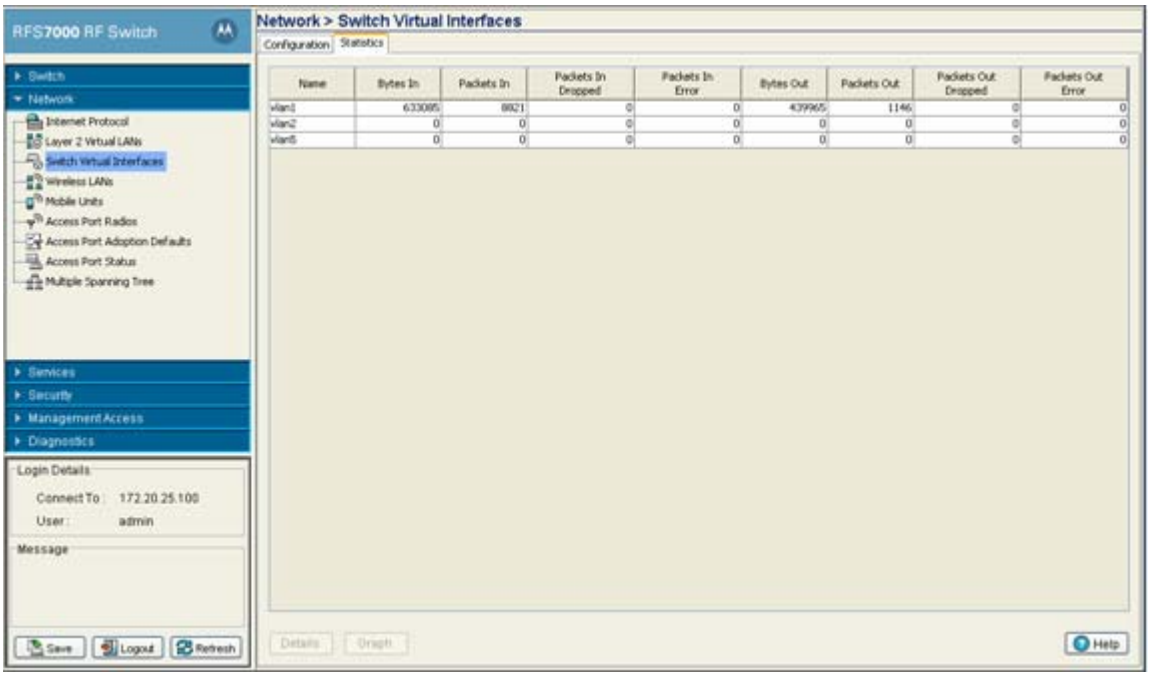
4.4.2 Viewing Virtual Interface Statistics

The **Statistics** screen displays information about packet level statistics and errors at the interface.

To view virtual interface statistics:

1. Select **Network** > **Switch Virtual Interface** from the main tree menu.

2. Select the **Statistics** tab.



3. Refer to the following to assess the network throughput of existing virtual interfaces:

Name	Displays the user defined interface name. The corresponding statistics are displayed along the row. The statistics are the total traffic to the interface since its creation.
Bytes In	Displays the number of bytes coming into the interface. The status is not self-updated. To view the current status, click the **Details** button.
Packets In	Displays the number of packets coming into the interface (including packets dropped, error packets, etc.).
Packets In Dropped	Displays the number of dropped packets coming into the interface. Packets are dropped if: 1. The input queue for the hardware device/software module handling the interface definition is saturated/full. 2. Overruns occur when the interface receives packets faster than it can transfer them to a buffer.

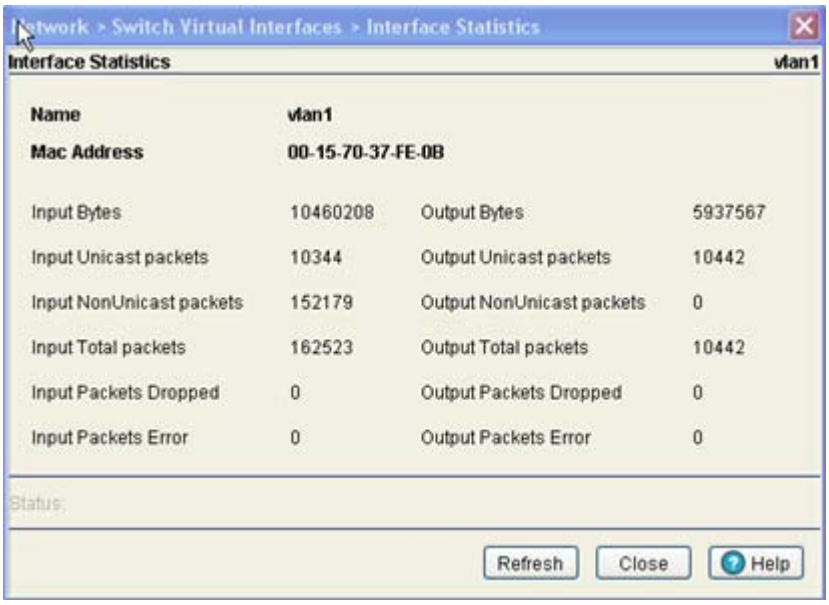
Packets In Error	Displays the number of error packets coming into the interface. It includes: • *Runt frames* — Packets shorter than the minimum Ethernet frame length (64 bytes). • *CRC errors* — The *Cyclical Redundancy Check* (CRC) is the 4 byte field at the end of every frame the receiving station uses to interpret if the frame is valid. If the CRC value computed by the interface does not match the value at the end of frame, it is considered as a CRC error. • *Late collisions* — A late collision is any collision that occurs after the first 64 octets of data have been sent by the sending station. Late collisions are not normal and are usually the result of out of specification cabling or a malfunctioning device. • *Misaligned frames* — A misaligned frame is a frame that somehow gets out of sync with the receiving station's receive clock recovery circuit. Misalignment is reported if the frame ends with a CRC error and extra bits are also detected.
Bytes Out	Displays the number of bytes going out on the interface.
Packets Out	Displays the number of packets going out on the interface.
Packets Out Dropped	Displays the number of dropped packets going out of the interface, due to saturated output queues assigned to the interface processor or the physical device/software module. Packets can be dropped due to collisions as well.
Packets Out Error	Displays the number of error packets going out of the interface, including frame forming errors or malformed packets transmitted over the interface.

3. Click the **Details** button to view packet level statistics of any user defined interface. For more information, see *Viewing Virtual Interface Statistics on page 4-20*.
4. Click the **Graph** button to view a graphical representation of the switch virtual interface statistics. For more information, see *Viewing the Virtual Interface Statistics Graph on page 4-21*.

4.4.2.1 Viewing Virtual Interface Statistics

To view detailed virtual interface statistics:

1. Select a virtual interface from the Statistics tab.
2. Click the **Details** button.



3. The **Interface Statistics** screen displays the following granular content for the selected interface:

Name	Displays the title of the logical interface selected.
MAC Address	Displays physical address information associated with the interface. This address is read-only (hard-coded at the factory) and cannot be modified.
Input Bytes	Displays the number of bytes received by the interface.
Input Unicast Packets	Displays the number of unicast packets (packets directed towards the interface) received at the interface.
Input NonUnicast Packets	Displays the number of NonUnicast Packets (Multicast and Broadcast Packets) received at the interface.
Input Total Packets	Displays the total number of packets received at the interface.
Input Packets Dropped	Displays the number of packets dropped at the interface by the input Queue of the hardware unit /software module associated with the VLAN interface. Packets are dropped when the input Queue of the interface is full or unable to handle incoming traffic.
Input Packets Error	Displays the number of packets with errors at the interface. Input Packet Errors are input errors occurring due to; no buffer space/ ignored packets due to broadcast storms, packets larger than maximum packet size, framing errors, input rate exceeding the receiver's date handling rate or cyclic redundancy check errors. In all these cases, an error is reported.
Output Bytes	Displays the number of bytes transmitted from the interface.

Output Unicast Packets	Displays the number of unicast packets (packets directed towards a single destination address) transmitted from the interface.
Output NonUnicast Packets	Displays the number of unicast packets transmitted from the interface.
Output Total Packets	Displays the total number of packets transmitted from the interface.
Output Packets Dropped	Displays the number of transmitted packets dropped at the interface. Output Packets Dropped are packets dropped when the output queue of the physical device associated with interface is saturated.
Output Packets Error	Displays the number of transmitted packets with errors. Output Packet Errors are the sum of all the output packet errors, malformed packets and misaligned packets received on an interface.

4. The **Status** is the current state of requests made from the applet. Requests are any "SET/GET" operation from the applet. The Status field displays error messages if something goes wrong in the transaction between the applet and the switch.
5. Click the **Refresh** button to refresh the virtual interface statistics. Status information is not polled to the applet. Hence you have to refresh the switch to retrieve the data.
6. Click the **Close** button to exit the screen. Clicking Close does not lose any data, as there are no values configured within this screen (it is read-only).

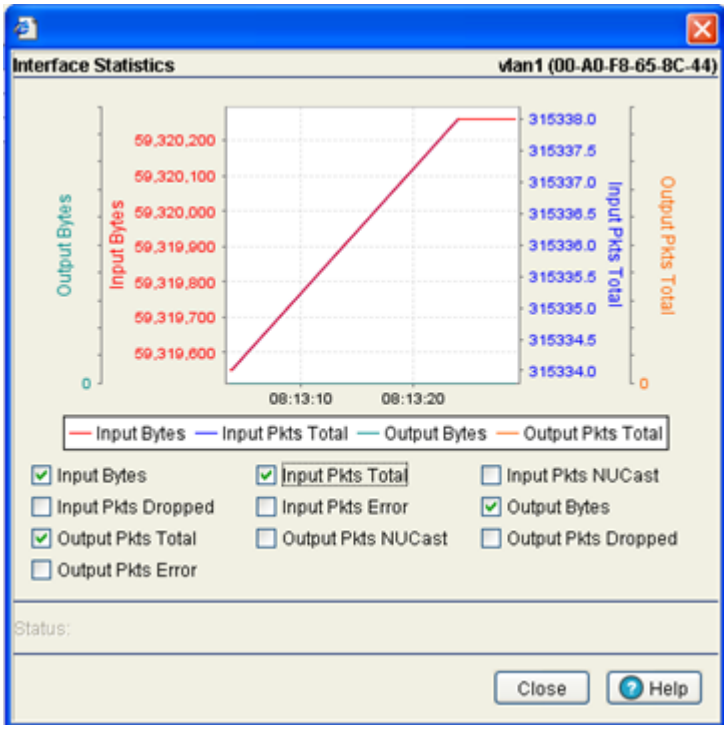
4.4.2.2 Viewing the Virtual Interface Statistics Graph

The switch Web UI continuously updates its virtual interface statistics, even when the graph is closed. Periodically display the virtual statistics graph for the latest information as network performance information is required.

To view a detailed graph for a selected interface:

1. Select a record from the table displayed in the **Statistics** screen.
2. Click the **Graph** button.
3. The Interface Statistics screen displays. The Interface Statistics screen provides the option of viewing graphical statistics for the following:
   - *Input Bytes*
   - *Input Pkts Dropped*
   - *Output Pkts Total*
   - *Output Pkts Error*
   - *Input Pkts Total*
   - *Input Pkts Error*
   - *Output Pkts NUCast*
   - *Input Pkts NUCast*
   - *Output Bytes*
   - *Output Pkts Dropped*

   Select any of the above parameters by clicking on the checkbox associated with it.



NOTE Do not select more than four parameters at any given time.

4. Refer to the **Status** field for the current state of the requests made from applet. This field displays error messages if something goes wrong in the transaction between the applet and the switch.
5. Click **Close** to close the dialog.

4.5 Viewing and Configuring Switch WLANs

A *wireless LAN* (WLAN) is a *local area network* (LAN) without wires. WLANs transfer data through the air using radio frequencies instead of cables. The WLAN screen displays a high-level overview of the WLANs created for the switch managed network. Use this data as necessary to the WLANs that are active, their VLAN assignments, updates to a WLAN's description and their current authentication and encryption scheme.The Wireless LANs screen is partitioned into 5 tabs supporting the following configuration activities:

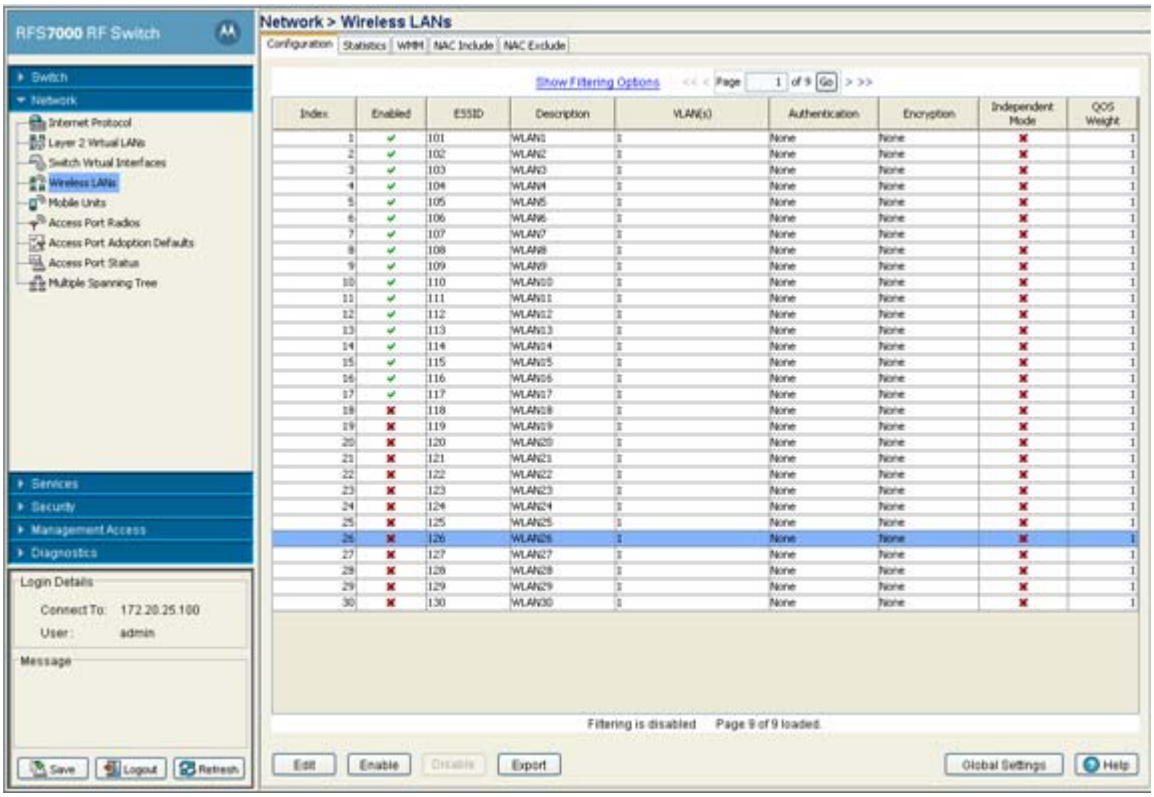
- *Configuring WLANs*
- *Viewing WLAN Statistics*
- *Configuring WMM*
- *Configuring the NAC Inclusion List*
- *Configuring the NAC Exclusion List*

4.5.1 Configuring WLANs

Refer to the **Configuration** screen for a high-level overview of the WLANs created for use within the switch-managed network. Use this data as necessary to keep current of active WLANs, their VLAN assignments, updates to a WLAN's description and their current authentication and encryption schemes. Be careful to properly map BSS WLANs and security schemes. A RFS7000 switch supports 256 WLANs.

To configure a WLAN:

1. Select **Network** > **Wireless LANs** from the main menu tree.
2. Click the **Configuration** tab.



The Configuration tab displays the following details:

Index	Displays the WLAN's numerical identifier. The WLAN index range is from 1 to 256. An index can be helpful to differentiate a WLAN from other WLANs with similar configurations.
Enabled	Refer to the Enabled parameter to discern whether the specified WLAN is enabled or disabled. When enabled, a green check mark displays. When disabled, a red "X" displays. To enable or disable a WLAN, select it from the table and click the Enable or Disable button.
ESSID	Displays the Service Set ID associated with each WLAN. Click the Edit button to modify the value to a new unique SSID.
Description	Displays a short description of the associated WLAN. Click the Edit button to modify the value the WLAN description.
VLAN	Displays the name of the VLAN the WLAN is associated with. The VLAN ID is an integer assigned for the corresponding user defined name. The VLAN ID can be between 1 and 4094. The default VLAN ID is 1.
Authentication	Displays the type of authentication used with the specified WLAN. Click the **Edit** button to modify the WLAN's current authentication scheme. For information on configuring an authentication scheme for a WLAN, see *Configuring Authentication Types on page 4-33*.
Encryption	Displays the type of wireless encryption used on the specified WLAN. When no encryption is used, the field displays "none". Click the **Edit** button to modify the WLAN's current encryption scheme. For information on configuring an authentication scheme for a WLAN, see *Configuring Different Encryption Types on page 4-50*.
Independent Mode	Determines whether the WLAN is functioning as an independent or extended WLAN in regards its support of *adaptive AP* (AAP) operation. Independent WLANs (defined by a green checkmark) are local to an AAP and configured from the switch. Specify a WLAN as independent for no traffic to be forward to the switch. Independent WLANs behave like WLANs as used on a a standalone access point. Extended WLAN (defined by the default red X) are typical centralized WLANs created on the switch. Select an existing WLAN to revise its default extended mode designation if intending to use the WLAN for AAP support. For more information, see *Editing the WLAN Configuration on page 4-27*.
QOS Weight	Defines the Quality of Service weight for the WLAN. WLAN QoS will be applied based on the QoS weight value with higher values assigned priority. The range for QoS. weight values is between 1 and 10 with 1 being the default value.

3. Click the **Edit** button to display a screen where WLAN information, encryption and authentication settings can be viewed or changed. For more information, see *Editing the WLAN Configuration on page 4-27*.
4. Click the **Enable** button to enable the selected WLAN. When enabled, a green check mark displays. When disabled, a red "X" displays. Enabled WLANs are display in a number of different switch Web UI configurations for additional configuration activities. To enable or disable a WLAN, select it from the table and click the Enable or Disable button. The Enable button is only available when the selected WLAN is disabled.
5. Click the **Disable** button to disable the selected WLAN. When enabled, a green check mark displays. When disabled, a red "X" displays. To enable or disable a WLAN, select it from the table and click the Enable or Disable button. The Disable button is only available when the selected WLAN is enabled.
6. Click the **Export** button to export the content of the table to a *Comma Separated Values* file (CSV).
7. Click the **Global Settings** button to display a screen with WLAN settings applying to the all the WLANs on the system. Remember, changes made to any one value impact each WLAN.

   Click **OK** to save updates to the Global WLAN Settings screen. Click **Cancel** to disregard changes and revert back to the previous screen. Checkbox options within the Global Settings screen include:

MU Proxy ARP handling	Enables Proxy ARP handling for MUs. Proxy ARP is provided for MU's in PSP mode whose IP address is known. The WLAN generates an ARP reply on behalf of a MU, if the MU's IP address is known. The ARP reply contains the MAC address of the MU (not the MAC address of WLAN Module). Thus, the MU does not awaken to send ARP replies (helping to increase battery life and conserve bandwidth). If an MU goes into PSP mode without transmitting at least one packet, its Proxy ARP will not work for the MU. This option is selected by deafult.
Shared-Key Authentication	Enables Shared-Key Authentication for all enabled WLANs on the system. This option is selected by default.

Manual Mapping of WLANs	Use this option (its selected by default) for custom WLAN to Radio mappings. When Advanced Configuration is disabled, the user cannot conduct Radio – WLAN mapping. Additionally, the user cannot enable WLANs with an index from 17 to 32. Once the Advanced Configuration option is enabled, the following conditions must be satisfied (to successfully disable it). No WLANs with index 17 to 32 should be enabled. Additionally, the Radio – WLAN mapping should conform to the following: BSS ID 1 – Possible WLANs 1,5,9,13 BSS ID 2 – Possible WLANs 2,6,10,14 BSS ID 3 – Possible WLANs 3,7,11,15 BSS ID 4 – Possible WLANs 4, 8, 12,16.
Enable WLAN Bandwidth Settings	Select this option to enable WLAN bandwidth settings. WLAN bandwidth settings ensures quality of service for applications regardless of network load. This option is selected by default.

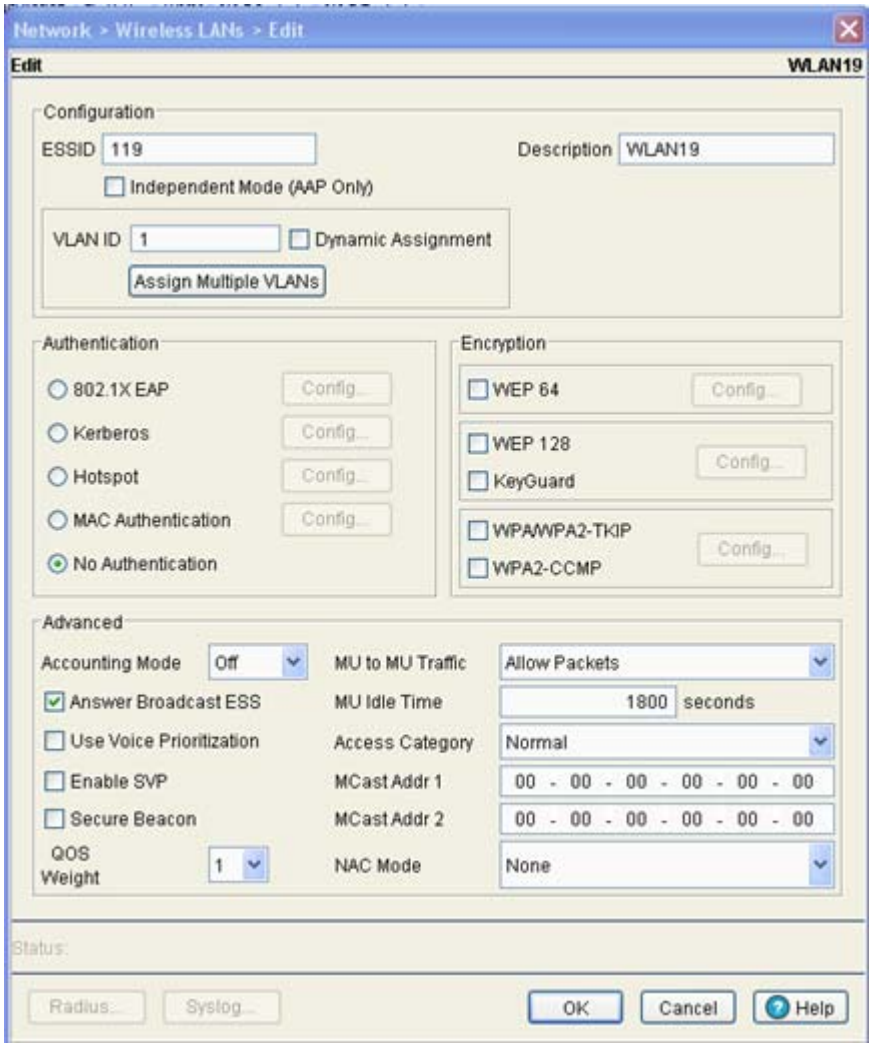
4.5.1.1 Editing the WLAN Configuration

Security measures for the switch and its WLANs are critical. Use the available switch security options to protect each WLAN from wireless vulnerabilities, and secure the transmission of RF packets between WLANs and the MU traffic they support.

The user has the capability of configuring separate security policies for each WLAN. Each security policy can be configured based on the authentication (Kerberos, 802.1x EAP, Hotspot) and /or encryption (WEP, KeyGuard, WPA/WPA2-TKIP or WPA2/CCMP) scheme.

All of the default WLANs are available for modification when the user accesses the Wireless LANs screen. However, the WLAN requires an authentication or encryption scheme be applied before it can begin securing the data traffic within the switch-managed wireless network. The Edit screen provides a mean of modifying the existing WLANs SSID, description, VLAN ID assignment, inter-WLAN communication definition and encryption and authentication scheme. To edit WLAN configuration settings:

1. Select **Network** > **Wireless LANs** from the main menu tree.
2. Click the **Configuration** tab.
3. Select a WLAN to edit from the table.
4. Click the **Edit** button.



The Wireless LANs Edit screen is divided into the following user-configurable fields:

- *Configuration*
- *Authentication*
- *Encryption*
- *Advanced*

5. Refer to the **Configuration** field to define the following WLAN values

ESSID	Displays the *Extended Service Set ID* (ESSID) associated with each WLAN. If changing the ESSID, ensure the value used is unique.
Description	If editing an existing WLAN, ensure its description is updated accordingly to best describe the intended function of the WLAN.
Independent Mode (AAP Only)	Determines whether the WLAN is functioning as an independent or extended WLAN in regards its support of *adaptive AP* (AAP) operation. Select the checkbox to designate the WLAN as independent and prevent traffic from being forwarded to the switch. Independent WLANs behave like WLANs as used on a a standalone access point. Leave this option unselected (as is by default) to keep this WLAN an extended WLAN (a typical centralized WLAN created on the switch). For an overview of AAP and how it is configured and deployed using the switch and access point, see *B.1 Adaptive AP Overview*.
VLAN ID	Assign the revised VLAN ID for this WLAN. Select the **Dynamic Assignment** checkbox for an user based VLAN assignment when 802.1x EAP Authentication is used.
Dynamic Assignment	Select the Dynamic Assignment checkbox for an automatic VLAN assignment. The switch cannot route traffic between different VLANs on ETH1 and ETH2. Be cognizant of this limitation when planning to route traffic between different VLANs.
Assign Multiple VLANs	The switch allows the mapping of a WLAN to more than one VLAN. As MUs get associated, they are assigned a VLAN in a load balanced manner. For more information, see *Assigning Multiple VLANs per WLAN on page 4-31*.

NOTE If the WLAN is to support AAP, the **Independent Mode (AAP Only)** checkbox must be selected. Additionally, the access point must have its auto discovery option enabled to be discovered by the switch. For information on configuring an access point for AAP support, see *B.4.1 Adaptive AP Configuration*.

NOTE For a Radius supported VLAN to function, the "Dynamic Assignment" checkbox must be enabled for the WLAN supporting the VLAN.

6. Refer to the **Authentication** field to select amongst the following options:

802.1X EAP	A Radius server is used to authenticate users. For detailed information on configuring EAP for the WLAN, see *Configuring 802.1x EAP on page 4-33*.
Kerberos	A Kerberos server is used to authenticate users. For detailed information on configuring Kerberos for the WLAN, see *Configuring Kerboros on page 4-34*.
Hotspot	A Hotspot is used to authenticate users in a unique network segment (hotspot). The attributes of both the hotspot and the Radius Server are required. For more information, see *Configuring Hotspots on page 4-35*.
MAC Authentication	The switch uses a Radius server to determine if a target MAC address is allowed on the network. The attributes of the Radius Server are required to implement MAC Authentication. For more information, see *Configuring MAC Authentication on page 4-43*
No Authentication	When selected, no Authentication is used and transmissions are made (in the open) without security unless an encryption scheme is used. This setting is not recommended when data protection is important.

7. Refer to the **Encryption** field to select amongst the following options:

WEP 64	Use the WEP 64 checkbox to enable the *Wired Equivalent Privacy* (WEP) protocol with a 40-bit key. WEP is available in two encryption modes: 40 bit (also called WEP 64) and 104 bit (also called WEP 128). The 104-bit encryption mode provides a longer algorithm that takes longer to decode than the 40-bit encryption mode. For detailed information on configuring WEP 64 for the WLAN, see *Configuring WEP 64 on page 4-50*.
WEP 128	Use the WEP 128 checkbox to enable the *Wired Equivalent Privacy* (WEP) protocol with a 104-bit key. WEP is available in two encryption modes: WEP 64 (using a 40-bit key) and WEP 128 (using a 104-bit key). WEP 128 encryption mode provides a longer algorithm that takes longer to decode than the WEP 64 encryption mode. For detailed information on configuring WEP 128 for the WLAN, see *Configuring WEP 128 / KeyGuard on page 4-51*.
KeyGuard	Uses a Motorola proprietary encryption mechanism to protect data. For detailed information on configuring KeyGuard for the WLAN, see *Configuring WEP 128 / KeyGuard on page 4-51*. Keyguard is only available on legacy Motorola devices.
WPA-WPA2-TKIP	Use the WPA-TKIP checkbox to enable *Wi-Fi Protected Access* (WPA) with *Temporal Key Integrity Protocol* (TKIP). For detailed information on configuring TKIP for the WLAN, see *Configuring WPA/WPA2 using TKIP and CCMP on page 4-52*.

WPA2-CCMP	WPA2 is a newer 802.11i standard that provides even stronger wireless security than *Wi-Fi Protected Access* (WPA) and WEP. CCMP is the security standard used by the *Advanced Encryption Standard* (AES). AES serves the same function TKIP does for WPA-TKIP. CCMP computes a *Message Integrity Check* (MIC) using the proven *Cipher Block Chaining* (CBC) technique. Changing just one bit in a message produces a totally different result. For detailed information on configuring CCMP for the WLAN, see *Configuring WPA/WPA2 using TKIP and CCMP on page 4-52*.

8. Refer to the **Advanced** field for the following information:

Accounting Mode	If using a Syslog server to conduct accounting for the switch, select the Syslog option from the **Accounting Mode** drop-down menu. Once selected, a **Syslog Config** button is enabled on the bottom of the Network > Wireless LANs > Edit screen. Use this sub screen to provide the Syslog Server IP address and port for the Syslog Server performing the accounting function. If either Hotspot, MAC Authentication or 802.1x EAP have been selected from within the Authentication field, a **Radius Config** button is enabled (on the bottom of the screen) allowing the user to define a Primary and Secondary Radius Accounting Server IP address, port, shared secret password and timeout and retry. Define these accounting settings as required for the switch. The default Accounting Mode setting is **Off**.
Answer Broadcast ESS	Select this checkbox to allow the WLAN to respond to probes for broadcast ESS.
Use Voice Prioritization	Select the Use Voice Prioritization option if Voice is used on the WLAN. This gives priority to voice packets and voice management packets and is supported only on certain legacy Motorola VOIP phones.
Enable SVP	Enabling SVP (*Spectralink Voice Prioritization*) allows the switch to identify and prioritize traffic from Spectralink/Polycomm phones.
Secure Beacon	Select this option to exclude the SSID of this WLAN within Beacon frames. This option still allows MU to MU communication within the WLAN.
QoS Weight	Defines the Quality of Service weight for the WLAN. WLAN QoS will be applied based on the QoS weight value with higher values assigned priority. The range for QoS. weight values is between 1 and 10 with 1 being the default value.
MU to MU Traffic	Allows frames from one MU (where the destination MAC is of another MU) are switched to a second MU. Use the drop-down menu to select one of the following options: • *Drop Packets* – Restricts MU to MU communication based on the WLAN's configuration • *Allow Packets* – Allows MU to MU communication based on the WLAN's configuration
MU Idle Time	Set the MUs idle time limit in seconds.

Access Category	Displays the Access Category for the intended traffic. The Access Categories different WLAN-WMM options available to the radio. The Access Category types are: • *Automatic/WMM* – Optimized for WMM • *Voice* – Optimized for voice traffic • *Video* – Optimized for video traffic • *Normal* – Optimized for best effort traffic • *Low* – Optimized for background traffic.
MCast Addr 1	The address provided takes packets (where the first 4 bytes match the first 4 bytes of the mask) and sends them immediately over the air instead of waiting for the DTIM period. Any multicast/broadcast that does not match this mask goes out only on DTIM Intervals.
MCast Addr 2	The second multicast address also takes packets (where the first 4 bytes match the first 4 bytes of the mask) and sends them immediately over the air instead of waiting for the DTIM period. Any multicast/broadcast that does not match this mask will go out only on DTIM Intervals.
NAC Mode	Using *Network Access Control* (NAC), the switch only grants access to specific network resources. NAC restricts access to only compliant and validated devices (printers, phones, PDAs etc.), thereby limiting the risk of emerging security risks. NAC performs an authorization check for users and MUs without a NAC agent, and verifies a MU's compliance with the network security policy. The switch supports only the EAP/802.1x type of NAC. However, the switch can bypass NAC for MU's without NAC 802.1x support. For the implications of using the include and exclude with NAC, see *Configuring the NAC Inclusion List on page 4-66* and *Configuring the NAC Exclusion List on page 4-70*.

9. Refer to the **Status** field for the current state of the requests made from applet. This field displays error messages if something goes wrong in the transaction between the applet and the switch.
10. Click on the **Radius...** button (when Radius is selected as the accounting mode) to configure an external primary and secondary Radius and NAC server. For more information, see *Configuring External Radius Server Support on page 4-43*.
11. Click on the **Syslog** button (when Syslog is selected as the accounting mode) to view switch syslog accounting details. To enable syslog, select the **Syslog** option from the Accounting Mode drop-down menu. Use this sub screen to provide the Syslog Server IP address and port for the Syslog Server performing the accounting function.
12. Click on the **NAC** button to configure the NAC mode. For more detailed information see *Configuring NAC Server Support on page 4-47*.
13. Click **OK** to use the changes to the running configuration and close the dialog.
14. Click **Cancel** to close the dialog without committing updates to the running configuration.

4.5.1.2 Assigning Multiple VLANs per WLAN

The switch allows the mapping of a WLAN to more than one VLAN. When a MU associates with a WLAN, it is assigned a VLAN in such a way that users are load balanced across VLANs. The VLAN is assigned from the

pool representative of the WLAN. The switch tracks the number of MUs per VLAN, and assigns the least used/loaded VLAN to the MU. This number is tracked on a per-WLAN basis.

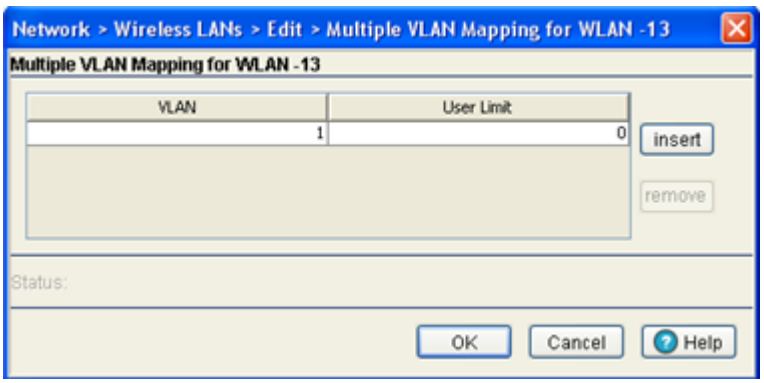
To assign multiple VLANs to a WLAN:

1. Select **Network** > **Wireless LANs** from the main menu tree.
2. Select an existing WLAN from those displayed within the **Configuration** tab and click the **Edit** button.

   A WLAN screen displays with the WLAN's existing configuration.
3. Revise the **VLAN ID** (if necessary).

   By default, all WLANs are initially assigned to VLAN 1.
4. Select the **Dynamic Assignment** checkbox for an user based VLAN assignment with Radius for this WLAN.
5. Select the **Assign Multiple VLAN(s)** button to map a WLAN to more than one VLAN. This displays the Multiple VLAN Mapping screen.
6. Configure the **Multiple VLAN Mapping for WLAN** table as required to add or remove multiple VLANS for the selected WLAN.

   Multiple VLAN's per WLAN are mapped (by default) to a regular VLAN and are not supported on an adaptive AP. Refer to *Editing the WLAN Configuration on page 4-27* to select and define an independent VLAN for adaptive AP support.



VLAN	Displays the VLANs currently mapped to the WLAN. By default, VLAN 1 is configured for any selected WLAN.
User Limit	Displays the user limit configured for the mapped VLAN. The maximum allowed user limit is 8192 per VLAN.

NOTE The maximum number of secondary IPs that can be assigned to a VLAN is 32.

7. Select the **Insert** button to add the VLAN using the criteria described above.
8. Select a row from the Multiple VLAN Mapping table and click the **Remove** button to delete the mapping of a VLAN to a WLAN.
9. Refer to the **Status** field for the current state of the requests made from applet. This field displays error messages if something goes wrong in the transaction between the applet and the switch.

10. Click **OK** to use the changes to the running configuration and close the dialog.
11. Click **Cancel** to close the dialog without committing updates to the running configuration

NOTE In a cluster environment with multiple switches, ensure the VLAN list is consistent across all switches.

4.5.1.3 Configuring Authentication Types

Refer to the following to configure the WLAN authentication options available on the switch:

- *Configuring 802.1x EAP*
- *Configuring Kerboros*
- *Configuring Hotspots*
  - *Configuring an Internal Hotspot*
  - *Configuring External Hotspot*
  - *Configuring Advanced Hotspot*
- *Configuring MAC Authentication*

Configuring 802.1x EAP

The IEEE 802.1x standard ties the 802.1x EAP authentication protocol to both wired and wireless LAN applications.

The EAP process begins when an unauthenticated supplicant (MU) tries to connect with an authenticator (in this case, the authentication server). The switch passes EAP packets from the client to an authentication server on the wired side of the switch. All other packet types are blocked until the authentication server (typically, a Radius server) verifies the MU's identity.

NOTE As part of the EAP configuration process, ensure a primary and optional secondary Radius server have been properly configured to authenticate the users requesting access to the EAP protected WLAN. For more information on configuring Radius Server support for the EAP 802.1x WLAN, see *Configuring External Radius Server Support on page 4-43*.

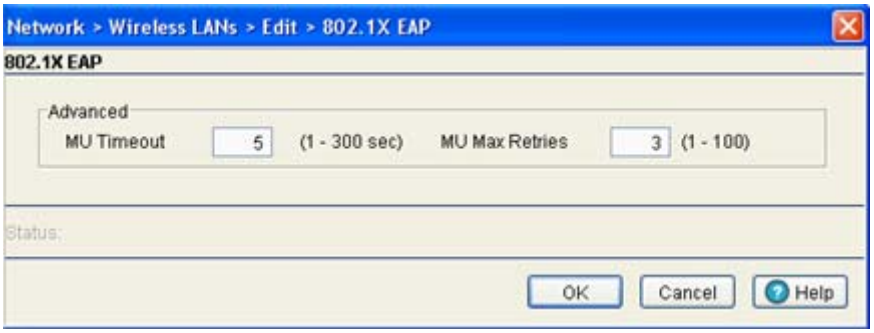
To configure a 802.1x EAP authentication scheme for a WLAN:

1. Select **Network** > **Wireless LANs** from the main menu tree.
2. Select an existing WLAN from those displayed within the **Configuration** tab and click the **Edit** button.

   A WLAN screen displays with the WLAN's existing configuration. Refer to the **Authentication** and **Encryption** columns to assess the WLAN's existing security configuration.
3. Select the **802.1X EAP** button from within the Authentication field.

   The **Radius Config...** button on the bottom of the screen becomes enabled. Ensure a primary and optional secondary Radius Server have been configured to authenticate users requesting access to the EAP 802.1x supported WLAN. For more information, see *Configuring External Radius Server Support on page 4-43*.
4. Click the **Config** button to the right of the 802.1X EAP checkbox.

The **802.1x EAP** screen displays.



5. Configure the **Advanced** field as required to define MU timeout and retry information for the authentication server.

MU Timeout	Define an interval (between 1- 300 seconds) for the switch's retransmission of EAP-Request packets. The default is 5 seconds.
MU Max Retries	Specify the maximum number of times the switch retransmits an EAP-Request frame to the client before it times out the authentication session. The default is 3 retries, with a maximum of 100 supported.

6. Refer to the **Status** field for the current state of the requests made from applet. This field displays error messages if something goes wrong in the transaction between the applet and the switch.
7. Click **OK** to use the changes to the running configuration and close the dialog.
8. Click **Cancel** to close the dialog without committing updates to the running configuration.

Configuring Kerboros

Kerberos (designed and developed by MIT) provides strong authentication for client/server applications using secret-key cryptography. Using Kerberos, a MU must prove its identity to a server (and vice versa) across an insecure network connection. Once a MU and server prove their identity, they can encrypt all communications to assure privacy and data integrity. Kerberos can only be used with Motorola clients.

CAUTION Kerberos makes no provisions for host security. Kerberos assumes it is running on a trusted host within an untrusted network. If host security is compromised, Kerberos is compromised as well.

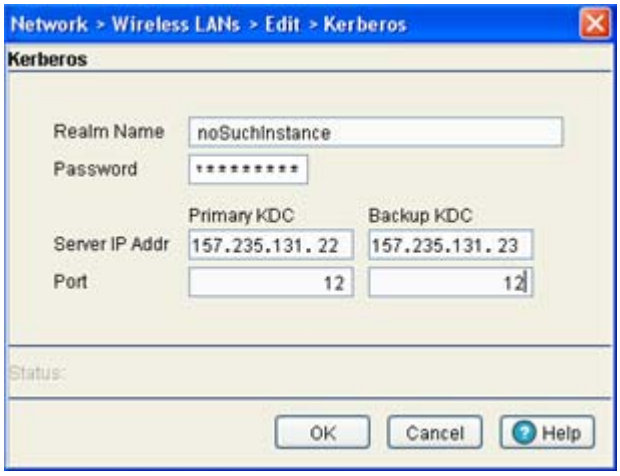
To configure a Kerberos authentication scheme for a WLAN:

1. Select **Network** > **Wireless LANs** from the main menu tree.
2. Select an existing WLAN from those displayed within the **Configuration** tab.
3. Click the **Edit** button.

   A WLAN screen displays with the WLAN's existing configuration. Refer to the **Authentication** and **Encryption** columns to assess the WLAN's existing security configuration.
4. Select the **Kerberos** button from within the Authentication field.

NOTE Kerberos requires at least one encryption scheme be enabled (WEP 128 or other). If neither WEP 128 or KeyGuard is enabled, WEP 128 will automatically be enabled for use with Kerberos.

5. Click the **Config** button to the right of the Kerberos checkbox. The **Kerberos** screen displays.



6. Specify a case-sensitive **Realm Name**.

   The realm name is the name domain/realm name of the KDC Server. A realm name functions similarly to a DNS domain name. In theory, the realm name is arbitrary. However, in practice a Kerberos realm is named by uppercasing the DNS domain name associated with hosts in the realm.

7. Provide the password required to effectively update Kerberos authentication credentials.
8. Enter a **Server IP Addr** (IP address) for the Primary and (if necessary) Backup KDC.

   Specify a numerical (non-DNS) IP address for the Primary *Key Distribution Center* (KDC). The KDC implements an Authentication Service and a Ticket Granting Service, whereby an authorized user is granted a ticket encrypted with the user's password. The KDC has a copy of every user password provided. Optionally, specify a numerical (non-DNS) IP address for a backup KDC. Backup KDCs are often referred to as slave servers.

9. Specify the **Ports** on which the Primary and Backup KDCs reside.

   The default port number for Kerberos Key Distribution Centers is port 88.

10. Refer to the **Status** field for the current state of requests made from applet. This field displays error messages if something goes wrong in the transaction between the applet and the switch.
11. Click **OK** to use the changes to the running configuration and close the dialog.
12. Click **Cancel** to close the dialog without committing updates to the running configuration.

Configuring Hotspots

A hotspot is essentially a Web page granting user access to the Internet (in this case within a switch managed WLAN). With the influx of Wi-Fi enabled mobile devices (laptops, PDAs etc.), hotspots are common and can be found at many airports, hotels and college campuses.

The switch enables hotspot operators to provide user authentication and accounting without a special client application. The switch uses a traditional Internet browser as a secure authentication device. Rather than rely on built-in 802.11security features to control association privileges, configure a WLAN with no WEP (an open network). The switch issues an IP address using a DHCP server, authenticates the user and grants the user access the Internet.

The hotspot feature supports both internal and external radius servers. It also supports the following three HTTP redirection options to satisfy various customer configurations:

1. Simple internal pre-built web-pages

2. External Web-pages
3. Customized internal Web page (using the Advanced feature in hotspot configuration)

When a user visits a public hotspot and wants to browse a Web page, they can boot up their laptop and associate with the local Wi-Fi network by entering the correct SSID. They then start a browser. The hotspot access controller forces this un-authenticated user to a Welcome page from the hotspot Operator that allows the user to login with a username and password. This form of IP-Redirection requires no special software on the client but its does require the client's WLAN adapter be set to receive its IP configuration through DHCP.

To configure a hotspot, create a WLAN ESSID and select Hotspot as the authentication scheme from the WLAN Authentication menu. This is simply another way to authenticate a WLAN user, as it would be impractical to authenticate visitors using 802.1x authentications. Having enabled a hotspot, you will need to configure it. There are 2 parts to the hotspot configuration process:

- *Setting up the Hotspot Web pages*
- *Setting up the Radius server.*

Switch Hotspot Redirection

The switch uses destination network address translation to redirect user traffic from a default home page to the login page. Specifically, when the switch receives an HTTP Web page request from the user (when the client first launches its browser after connecting to the WLAN), a protocol stack on the switch intercepts the request and sends back an HTTP response after modifying the network and port address in the packet (thereby acting like a proxy between the User and the Web site they are trying to access).

Refer to the following scenario. An unauthenticated hotspot client associates to the hotspot WLAN. The client WLAN adapted initiates a DHCP broadcast. The switch detects this as DHCP broadcast traffic from an unauthenticated hotspot WLAN client. The switch forwards these frames to the DHCP server and does not redirect them. The DHCP server responds with an IP configuration for the client and the client is now ready to access the network.

The user then initiates an HTTP session to *www.xyz.com.* The switch detects this as DNS traffic, and again does not redirect it. The DNS server resolves this domain name to an IP address like 63.44.56.98 (for www.xyz.com). The client initiates a TCP session with host 63.44.56.98. This session begins with the client sending a TCP SYN to target IP 63.44.56.98. The switch intercepts this session and responds with a SNY/ACK back to the client (while in the process modifying the source IP address and source port of this return packet to 63.44.56.98:80). The client completes the TCP 3-way handshake with the switch acting as a proxy for the destination IP 63.44.56.98.

Assuming the TCP session opened, the client now sends an HTTP GET to the destination URL. The HTTP GET is again intercepted by the switch and redirected to the hotspot Web site https://10.0.1.77:444/wlan1/login.html. The client is now redirected to the Login.htm Web page of the hotspot instead of landing on their destination Web site (www.xyz.com). The client enters its identification information and is authenticated with the Radius server. Once authenticated, the client is presented with a Welcome.htm page. All client traffic is authenticated and forwarded to the Internet (until the user session expires).

To configure hotspot support:

1. Select **Network** > **Wireless LANs** from the main menu tree.
2. Select an existing WLAN from those displayed within the **Configuration** tab and click the **Edit** button.

   A WLAN screen displays with the WLAN's existing configuration. Refer to the **Authentication** and **Encryption** columns to assess the WLAN's existing security configuration.

3. Select the **Hotspot** button from within the Authentication field. The **Radius Config...** button on the bottom of the screen becomes enabled. Ensure a primary and optional secondary Radius Server have been configured to authenticate users requesting access to the hotspot supported WLAN. For more information, see *Configuring External Radius Server Support on page 4-43*.
4. Click the **Config** button to the right of the Hotspot checkbox.

   A **Hotspot** screen displays, allowing the user to define one of three available hotspot types.
5. Use the drop-down menu at the top of the screen to define whether this WLAN's Web pages are:
   - *Internal* - Three HTML pages with basic functionality are made available on the switch's onboard HTTP server. The HTML pages are pre-created to collect login credentials through Login.htm, send them to a Radius server and display a Welcome.htm or a Faliure.htm depending on the result of the authentication attempt. For more information, see *Configuring an Internal Hotspot on page 4-37*.
   - *External* - A customer may wish to host their own external Web server using advanced Web content (using XML, Flash). Use the External option to point the switch to an external hotspot. For more information, see *Configuring External Hotspot on page 4-39*.
   - *Advanced* - A customer may wish to use advanced Web content (XML, Flash) but might not have (or would not want to use) an external Web server, choosing instead to host the Web pages on the switch's HTTP Web server. Selecting the Advanced option allows for the import of Web pages from an external source (like an FTP server) and hosting them on the switch. For more information, see *Configuring Advanced Hotspot on page 4-41*.

NOTE The appearance of the Hotspot screen differs depending on which option is selected from the drop-down menu. You may want to research the options available before deciding which hotspot option to select.

NOTE As part of the hotspot configuration process, ensure a primary and optional secondary Radius Server have been properly configured to authenticate the users requesting access to the hotspot supported WLAN. For more information on configuring Radius Server support for the hotspot supported WLAN, see *Configuring External Radius Server Support on page 4-43*.

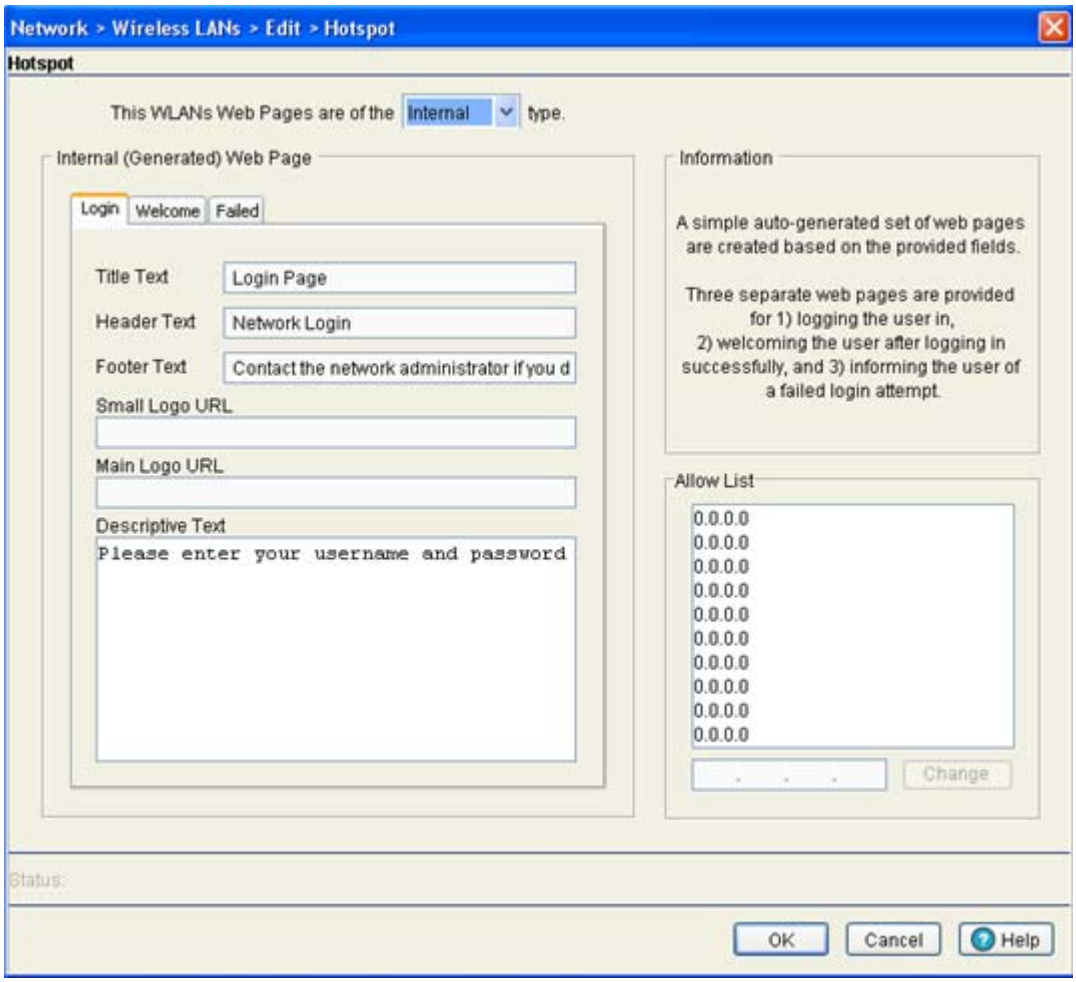
Configuring an Internal Hotspot

Using the Internal option means the user develops the hotspot using the three HTML pages made available on the switch's onboard HTTP server. The HTML pages are pre-created to collect login credentials through Login.htm, send them to a Radius server and display a Welcome.htm or a Faliure.htm depending on the result of the authentication attempt.

To create a hotspot maintained by the switch's own internal resources:

1. Select **Network** > **Wireless LANs** from the main menu tree.
2. Select an existing WLAN from those displayed within the **Configuration** tab and click the **Edit** button.

3. Select the **Hotspot** button from within the Authentication field. Ensure **Internal** is selected from within the **This WLAN's Web Pages are of the** drop-down menu.


Network > Wireless LANs > Edit > Hotspot
Hotspot
This WLANs Web Pages are of the Internal type.
Internal (Generated) Web Page
Login
Welcome
Failed
Title Text
Login Page
Header Text
Network Login
Footer Text
Contact the network administrator if you d
Small Logo URL
Main Logo URL
Descriptive Text
Please enter your username and password
Information
A simple auto-generated set of web pages are created based on the provided fields.
Three separate web pages are provided for 1) logging the user in, 2) welcoming the user after logging in successfully, and 3) informing the user of a failed login attempt.
Allow List
0.0.0.0
Change
Status:
OK
Cancel
Help

4. Click the **Login** tab and enter the title, header, footer Small Logo URL, Main Logo URL and Descriptive Text you would like to display when users login to the switch maintained hotspot.

Title Text	Displays the HTML text displayed on the Welcome page when using the switch's internal Web server. This option is only available if Internal is chosen from the drop-down menu.
Header Text	Displays the HTML header displayed on the Failed page when using the switch's internal Web server. This option is only available if Internal is chosen from the drop-down menu.
Footer Text	Displays the HTML footer text displayed on the Failed page when using the switch's internal Web server. This option is only available if Internal is chosen from the drop-down menu.
Small Logo URL	Displays the URL for a small logo image displayed on the Failed page when using the switch's internal Web server. This option is only available if Internal is chosen from the drop-down menu.
Main Logo URL	Displays the URL for the main logo image displayed on the Failed page when using the switch's internal Web server. This option is only available if Internal is chosen from the drop-down menu.

Descriptive Text	Specify any additional text containing instructions or information for the users who access the Failed page. This option is only available if Internal is chosen from the drop-down menu. The default text is: "Either the username and password are invalid, or service is unavailable at this time."

5. Refer to the **Allow List** field, and enter any IP address (for internal or external Web sites) accessed by the Hotspot user without authentication.

NOTE An associated MU may not be able to ping the host within the hotspot. For instance, a hotspot supported WLAN is enabled. Within the Allowed List, a network (157.235.95.0) is added. An MU is associated, and an IP address is obtained for the MU. The MU is then unsuccessful in pinging the host IP address (157.235.95.54) from within the hotspot. Consequently, the Allowed List should be used for host IPs only.

NOTE In multi-switch hotspot environments if a single switch's internal pages are configured for authentication on the other switches, those switches will redirect to their own internal pages instead. In these environments is recommended to use an external server for all of the switches.

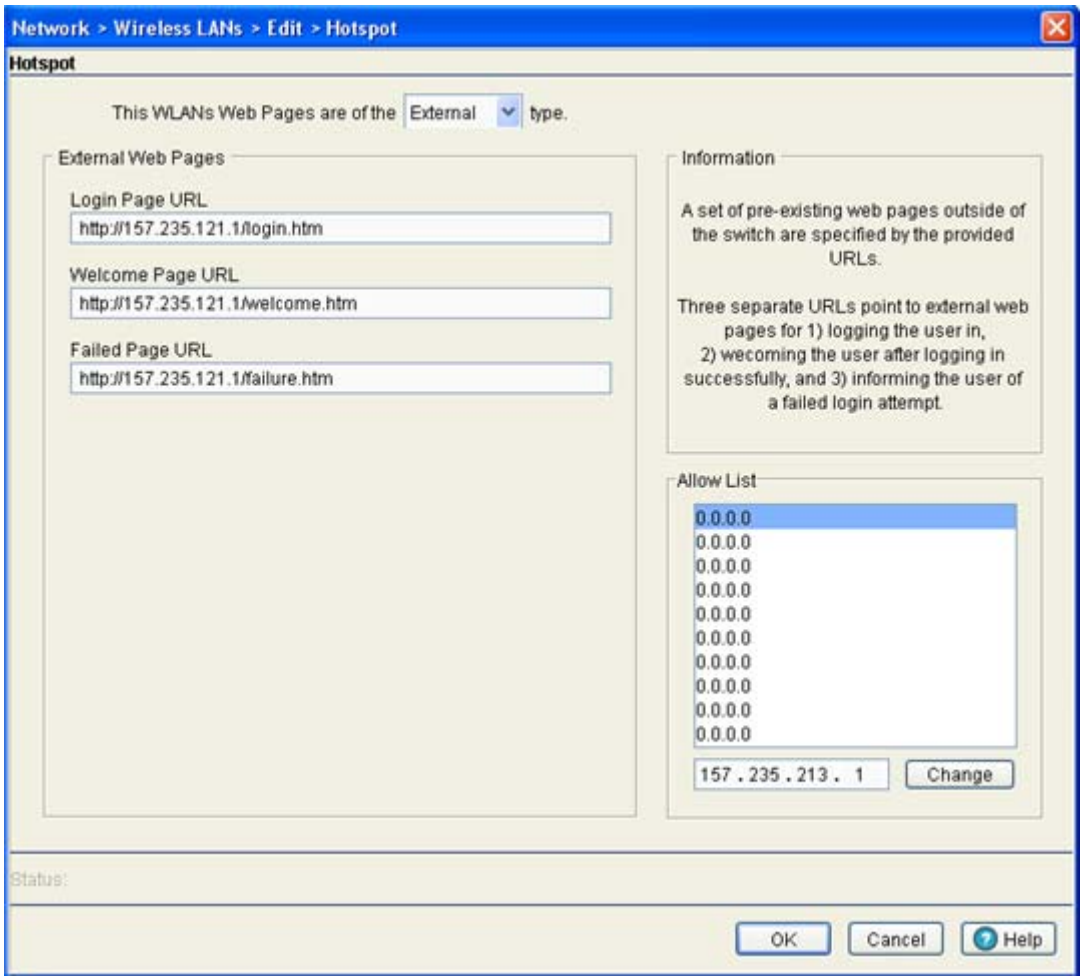
6. Refer to the **Status** field for the current state of the requests made from applet. This field displays error messages if something goes wrong in the transaction between the applet and the switch.
7. Click **OK** to use the changes to the running configuration and close the dialog.
8. Click **Cancel** to close the dialog without committing updates to the running configuration.

Configuring External Hotspot

Selecting the external option entails hosting your own external Web server using advanced Web content (using XML, Flash). To create a hotspot maintained by an external server:

1. Select **Network** > **Wireless LANs** from the main menu tree.
2. Select an existing WLAN from those displayed within the **Configuration** tab and click the **Edit** button.

3. Select the **Hotspot** button from within the Authentication field. Ensure **External** is selected from within the **This WLAN's Web Pages are of the** drop-down menu.



4. Refer to the **External Web Pages** field and provide the Login, Welcome and Failed Page URLs used by the external Web server to support the hotspot.

Login Page URL	Define the complete URL for the location of the Login page. The Login screen will prompt the hotspot user for a username and password to access the Welcome page.
Welcome Page URL	Define the complete URL for the location of the Welcome page. The Welcome page assumes the hotspot user has logged in successfully and can access the Internet.
Failed Page URL	Define the complete URL for the location of the Failed page. The Failed screen assumes the hotspot authentication attempt has failed, you are not allowed to access the Internet and you need to provide correct login information to access the Web.

NOTE When using an external hotspot page for redirection, certain HTML codes must be included on the pages to properly redirect to the switch.
For the **Login** and **Welcome** pages, the following code must be modified:

form action="https ://<ip address of the switch>:444/cgi-bin/hslogin.cgi" method="POST
"

For the Welcome page the following code must also be modified:

href="http://<ip address of the web server>/login.htm

If the above code is not modified and included, switch redirection may not work.

5. Refer to the **Allow List** field, and enter any IP address (for internal or external Web sites) that may be accessed by the Hotspot user without authentication.

NOTE In certain instances, an associated MU may not be able to ping the host within the hotspot. For instance, a hotspot supported WLAN is enabled. Within the Allowed List, a network (157.235.95.0) is added. An MU is associated, and an IP address is obtained for the MU. The MU is then unsuccessful in pinging the host IP address (157.235.95.54) from within the hotspot. Consequently, the Allowed List should be used for host IPs only.

NOTE If the Web-server is located on a VLAN other than the one on which the MUs will be associated, specify the IP address for the VLAN on which the server is located within the **Allow List**.

6. Refer to the **Status** field for the current state of the requests made from applet. This field displays error messages if something goes wrong in the transaction between the applet and the switch.
7. Click **OK** to use the changes to the running configuration and close the dialog.
8. Click **Cancel** to close the dialog without committing updates to the running configuration.

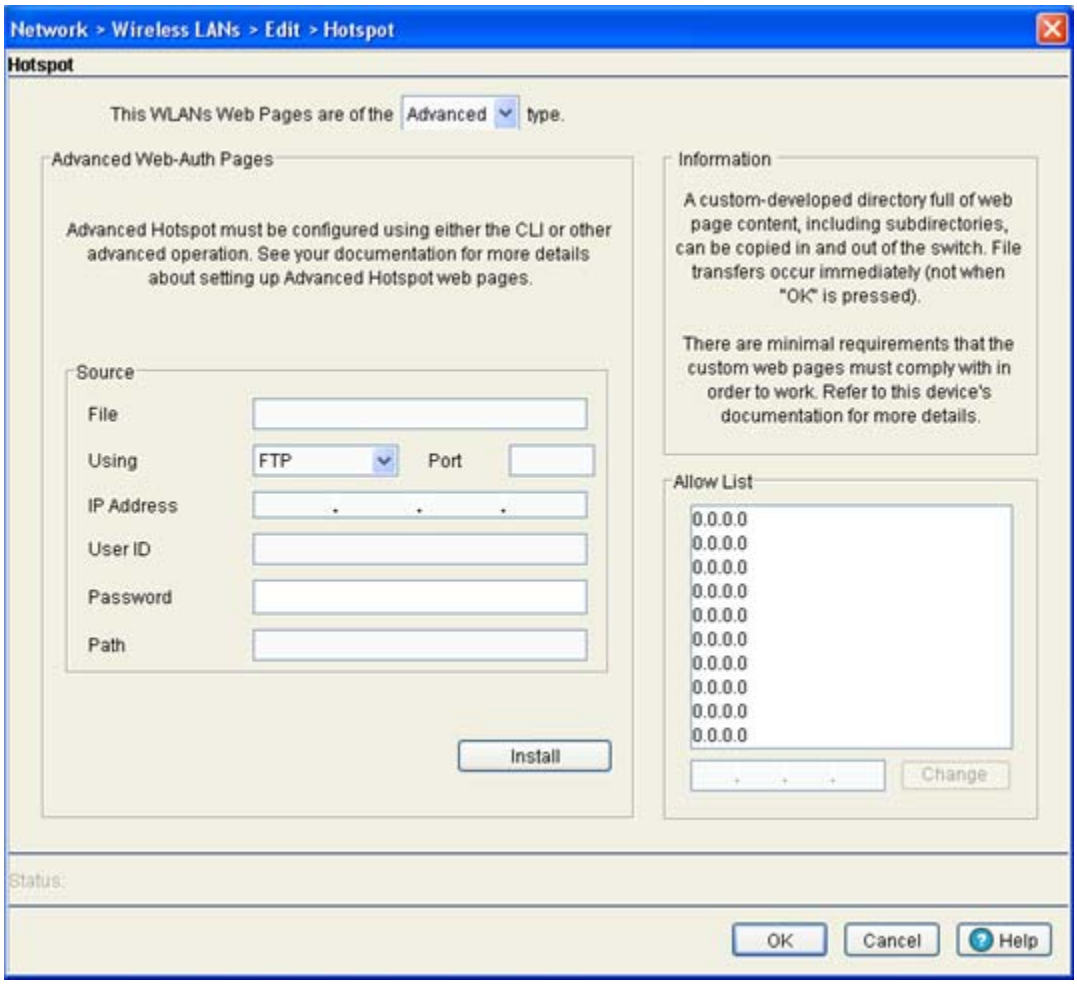
Configuring Advanced Hotspot

A customer may wish to use advanced Web content (XML, Flash) but might not have (or would not want to use) an external Web server, choosing instead to host the Web pages on the switch's HTTP Web server. Selecting the Advanced option allows for importing the Web pages from an external source (like an FTP server) and hosting them on the switch.

To use the Advanced option to define the hotspot:

1. Select **Network** > **Wireless LANs** from the main menu tree.
2. Select an existing WLAN from those displayed within the **Configuration** tab.
3. Click the **Edit** button.
4. Select the **Hotspot** button from within the Authentication field.

Ensure **Advanced** is selected from within the **This WLAN's Web Pages are of the** drop-down menu.


Network > Wireless LANs > Edit > Hotspot
Hotspot
This WLANs Web Pages are of the Advanced type.
Advanced Web-Auth Pages
Advanced Hotspot must be configured using either the CLI or other advanced operation. See your documentation for more details about setting up Advanced Hotspot web pages.
Source
File
Using
FTP
Port
IP Address
User ID
Password
Path
Install
Information
A custom-developed directory full of web page content, including subdirectories, can be copied in and out of the switch. File transfers occur immediately (not when "OK" is pressed).
There are minimal requirements that the custom web pages must comply with in order to work. Refer to this device's documentation for more details.
Allow List
0.0.0.0
Change
Status:
OK
Cancel
Help

NOTE Advanced hotspot configuration is not permissible using the switch Web UI. Refer to the switch CLI or other advanced configuration options to define a hotspot with advanced properties. However, the switch can still install and maintain directories containing Web page content.

5. Once the properties of the advanced hotspot have been defined, the file can be installed on the switch and used to support the hotspot. The following parameters are required to upload the file:
   a. Specify a source hotspot configuration file. The file used at startup automatically displays within the **File** parameter.
   b. Refer to the **Using** drop-down menu to configure whether the hotspot file transfer is conducted using FTP or TFTP.
   c. Enter the **IP Address** of the server or system receiving the source hotspot configuration. Ensure the IP address is valid or risk jeopardizing the success of the file transfer.
   d. If using FTP, enter the **User ID** credentials required to transfer the configuration file from a FTP server.
   e. If using FTP, enter the **Password** required to send the configuration file from an FTP server.

f. Specify the appropriate **Path** to the hotspot configuration on the local system disk or server.

g. Once the location and settings for the advanced hotspot configuration have been defined, click the **Install** button to use that hotspot configuration with the switch.

6. Refer to the **Allow List** field, and enter any IP address (for internal or external Web sites) that can be accessed by the Hotspot user without authentication.

NOTE In certain instances, an associated MU may not be able to ping the host within the hotspot. For instance, a hotspot supported WLAN is enabled. Within the Allowed List, a network (157.235.95.0) is added, an MU is associated, and an IP address is obtained for the MU. The MU is then unsuccessful in pinging the host IP address (157.235.95.54) from within the hotspot. Consequently, the Allowed List should be used for host IPs only.

7. Refer to the **Status** field for the current state of the requests made from applet. This field displays error messages if something goes wrong in the transaction between the applet and the switch.
8. Click **OK** to use the changes to the running configuration and close the dialog.
9. Click **Cancel** to close the dialog without committing updates to the running configuration.

Configuring MAC Authentication

The Dynamic MAC ACL option allows the user to configure a Radius server for user authentication with the range of MAC addressees defined as allowed or denied access to the switch managed network.

NOTE As part of the Dynamic MAC ACL configuration process, ensure a primary and optional secondary Radius Server have been properly configured to authenticate users requesting access to the ACL supported WLAN. For more information on configuring Radius Server support for the Dynamic MAC ACL supported WLAN, see *Configuring External Radius Server Support on page 4-43*.

Configuring External Radius Server Support

If either the EAP 802.1x, Hotspot or Dynamic MAC ACL options have been selected as an authentication scheme for a WLAN, the **Radius Config...** button at the bottom of the Network > Wireless LANs > Edit becomes enabled. The Radius Configuration screen provides users the option of defining an external primary and secondary Radius Server as well as a NAC Server if you elect not use the switch's resident resources.

NOTE If using the switch's local Radius Server for user authentication instead of an external primary or secondary Radius Server, see *Configuring the Radius Server on page 6-71*. To review the benefits and risks associated with selecting an external or local Radius Server as the primary user authentication scheme, see *Using the Switch's Radius Server Versus an External Radius Server on page 6-73*.

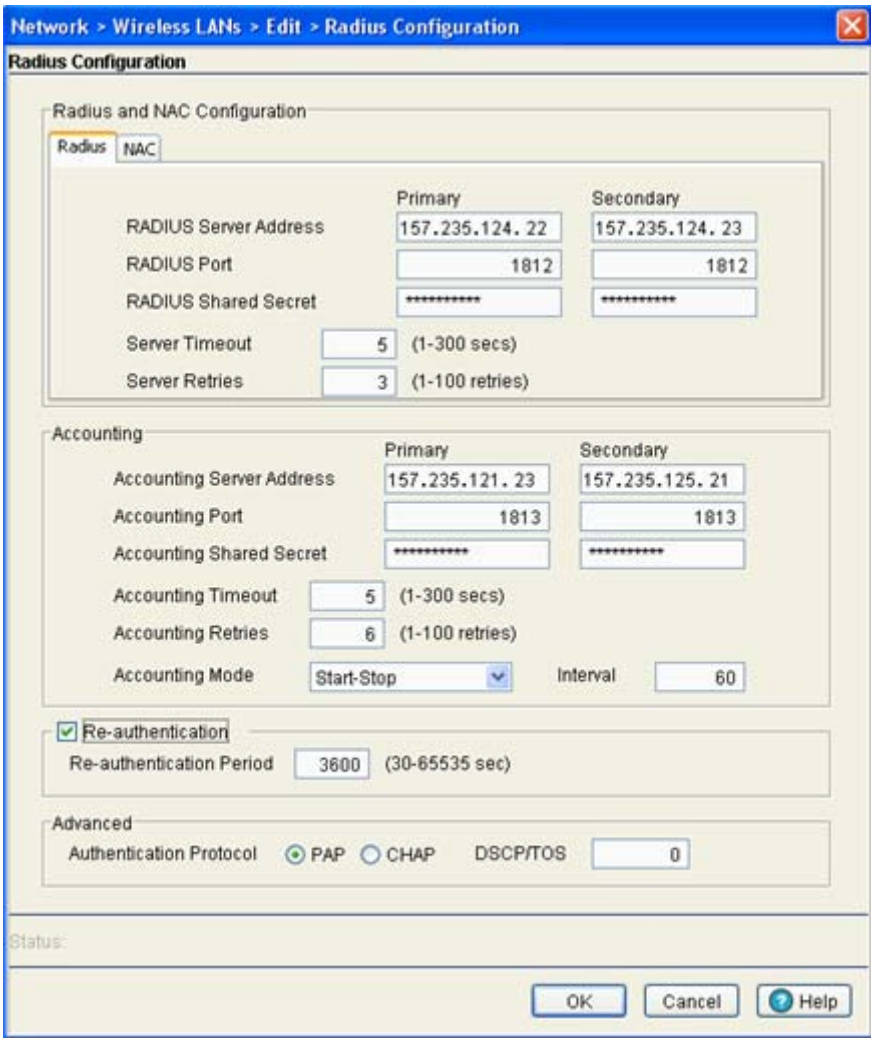
The switch ships with a default configuration defining the local Radius Server as the primary authentication source (default users are admin with superuser privileges and operator with monitor privileges). No secondary authentication source is specified. However, Motorola recommends using an external Radius Server as the primary user authentication source and the local switch Radius Server as the secondary user authentication source. To use an external Radius Server as either a primary or secondary authentication source, it must be specified appropriately.

CAUTION If using an external Radius Server as the primary authentication source and no secondary source is specified (either external or local), all users attempting to access the switch managed network will be granted access if the primary server becomes unreachable.

To configure an external Radius Server for EAP 802.1x, Hotspot or Dynamic MAC ACL WLAN support:

CAUTION To optimally use an external Radius Server with the switch, Motorola recommends defining specific external Server attributes to best utilize user privilege values for the switch. For information on defining the external Radius Server configuration, see *Configuring an External Radius Server for Optimal Switch Support on page 4-47*.

1. Select **Network** > **Wireless LANs** from the main menu tree.
2. Select an existing WLAN from those displayed within the **Configuration** tab.
3. Click the **Edit** button.
4. Select either the **EAP 802.1x, Hotspot** or **Dynamic MAC ACL** button from within the Authentication field. This enables the **Radius Conig...** button at the bottom of the Network > Wireless LANs > Edit screen.
5. Select the **Radius Conig...** button. The Radius Configuration screen displays (with the Radius tab displayed by default) for defining an external Radius or NAC Server.



The Radius Configuration screen contains tabs for defining both the Radius and NAC server settings. For a NAC overview, see *Configuring NAC Server Support on page 4-47*.

6. Refer to the **Server** field and define the following credentials for a primary and secondary Radius server.

RADIUS Server Address	Enter the IP address of the primary and secondary server acting as the Radius user authentication data source.
RADIUS Port	Enter the TCP/IP port number for the primary and secondary server acting as the Radius user authentication data source. The default port is 1812.
RADIUS Shared Secret	Provide a shared secret (password) for user credential authentication with the primary or secondary Radius server.
Server Timeout	Enter a value (between 1 and 300 seconds) to indicate the number of elapsed seconds causing the switch to time out on a request to the primary or secondary server.

Server Retries	Enter a value between 1 and 100 to indicate the number of times the switch attempts to reach the primary or secondary Radius server before giving up.

CAUTION The Radius or NAC server's **Timeout** and **Retries** should be less than what is defined for an MU's timeout and retries. If the MU's time is less than the server's, a fall back to the secondary server will not work.

7. Refer to the **Accounting** field and define the following credentials for a primary and secondary Radius Server.

Accounting Server Address	Enter the IP address of the primary and secondary server acting as the Radius accounting server.
Accounting Port	Enter the TCP/IP port number for the primary and secondary server acting as the Radius accounting data source. The default port is 1813.
Accounting Shared Secret	Provide a shared secret (password) for user credential authentication with the primary or secondary Radius accounting server.
Accounting Timeout	Enter a value (between 1 and 300 seconds) to indicate the number of elapsed seconds causing the switch to time out a request to the primary or secondary accounting server.
Accounting Retries	Enter a value between 1 and 100 to indicate the number of times the switch attempts to reach the primary or secondary Radius accounting server before giving up.
Accounting Mode	Use the Accounting Mode drop-down menu to define the accounting mode as either **Start-Stop**, **Stop Only** or **Start-Interim-Stop**. Define the interval (in seconds) used with the selected accounting mode.

8. Select the **Re-authentication** checkbox to force a periodic re-authentication with the Radius server. Periodic repetition of the authentication process provides ongoing security for currently authorized connections. Define an interval between 30 and 65535 seconds.
9. Refer to the **Advanced** field to define the authentication protocol used with the Radius Server.

PAP	PAP - *Password Authentication Protocol* sends a username and password over a network to a server that compares the username and password to a table of authorized users. If the username and password are matched in the table, server access is authorized.
CHAP	CHAP is an encrypted authentication method based on Microsoft's challenge/response authentication protocol.
DSCP/TOS	Optionally mark packets with a *DiffServ CodePoint* (DSCP) in its header. The DSCP value is stored in the first 6 bits of the Type of Service (ToS) field that is part of the standard IP header. The DCSP values are associated with a forwarding treatment called *Per Hop Behaviors* (PHB). Service can be provisioned (if necessary) by assigning a DCSP point code from 1 - 6.

10. Click **OK** to save the changes made to this screen.

11. Click **Cancel** to revert back to the last saved configuration and move back to the Network > Wireless LANs > Edit screen.

Configuring an External Radius Server for Optimal Switch Support

The switch's external Radius Server should be configured with Motorola RFS7000 specific attributes to best utilize the user privilege values assignable by the Radius Server. The following two values should be configured on the external Server for optimal use with the switch:

- *Motorola user privilege values*
- *User login source*

Configuring NAC Server Support

There is an increasing proliferation of insecure devices (laptops, mobile computers, PDA, smart-phones) accessing WiFi networks. These devices often lack proper anti-virus software and can potentially infect the network they access. Device compliance per an organization's security policy must be enforced using NAC. A typical security compliance check entails verifying the right operating system patches, anti-virus software etc.

NAC is a continuous process for evaluating MU credentials, mitigating security issues, admitting MUs to the network and monitoring MUs for compliance with globally-maintained standards and policies. If a MU is not in compliance, network access is restricted by quarantining the MU.

Using NAC, the switch hardware and software grants access to specific network devices. NAC performs a user and MU authorization check for devices without a NAC agent. NAC verifies a MU's compliance with the switch's security policy. The switch supports only EAP/802.1x NAC. However, the switch provides a mean to bypass NAC authentication for MU's without NAC 802.1x support (printers, phones, PDAs etc.).

For a NAC configuration example using the switch CLI, see *NAC Configuration Examples Using the Switch CLI on page 4-73*.

NAC can be configured in the following 3 modes:

- *None* – NAC disabled, no NAC is conducted. A MU can only be authenticated by a Radius server.
- *Do NAC except exclude list* – A MU NAC check is conducted except for those in the exclude-list. Devices in the exclude-list will not have any NAC checks.
- *Bypass NAC except include list* – A MU NAC check is conducted only for those MUs in the include-list.

For more information on defining the configuration of the NAC include and exclude lists, see *Configuring the NAC Inclusion List on page 4-66* or *Configuring the NAC Exclusion List on page 4-70*.

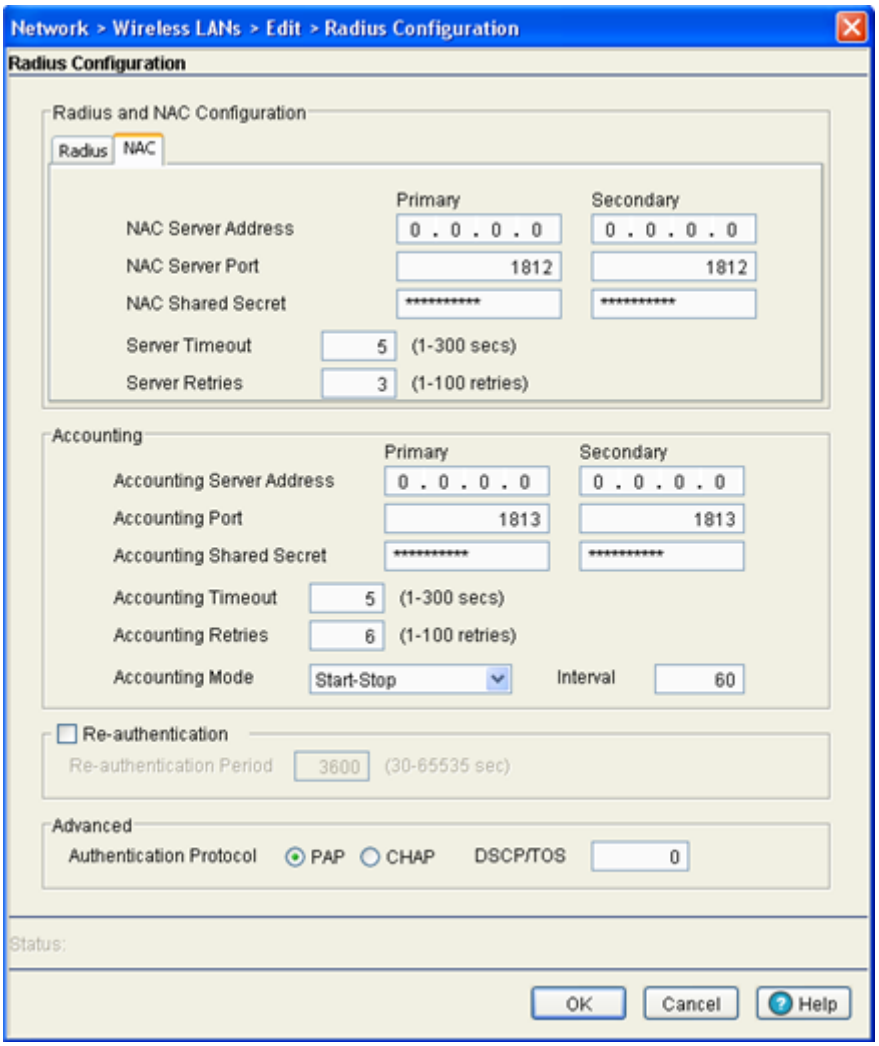
To configure NAC Server support:

1. Select **Network** > **Wireless LANs** from the main menu tree.
2. Select an existing WLAN from those displayed with the **Configuration** tab.
3. Click the **Edit** button.
4. Select either the **EAP 802.1x**, **Hotspot** or **Dynamic MAC ACL** button from within the Authentication field.

   This enables the Radius button at the bottom of the *Network > Wireless LANs > Edit* screen.
5. Select the **Radius** button.

   The Radius Configuration screen displays (with the Radius tab displayed by default) for defining an external Radius or NAC Server.

6. Select the **NAC** tab to configure NAC support.



7. Refer to the **Server** field and define the following credentials for a primary and secondary NAC server.

NAC Server Address	Enter the IP address of the primary and secondary NAC server.
NAC Server Port	Enter the TCP/IP port number for the primary and secondary server. The default port is 1812.
NAC Shared Secret	Provide a shared secret (password) for user credential authentication with the primary or secondary NAC server.
Server Timeout	Enter a value (between 1 and 300 seconds) to indicate the number of elapsed seconds causing the switch to time out on a request to the primary or secondary NAC server.
Server Retries	Enter a value between 1 and 100 to indicate the number of times the switch attempts to reach the primary or secondary server before giving up.

CAUTION The server's **Timeout** and **Retries** should be less than what is defined for an MU's timeout and retries. If the MU's time is less than the server's, a fall back to the secondary server will not work.

8. Refer to the **Accounting** field and define the following credentials for a primary and secondary NAC Server.

Accounting Server Address	Enter the IP address of the primary and secondary server acting as the NAC accounting server.
Accounting Port	Enter the TCP/IP port number for the primary and secondary server acting as the NAC accounting data source. The default port is 1813.
Accounting Shared Secret	Provide a shared secret (password) for user credential authentication with the primary or secondary NAC accounting server.
Accounting Timeout	Enter a value (between 1 and 300 seconds) to indicate the number of elapsed seconds causing the switch to time out a request to the primary or secondary accounting server.
Accounting Retries	Enter a value between 1 and 100 to indicate the number of times the switch attempts to reach the primary or secondary NAC accounting server before giving up.
Accounting Mode	Use the Accounting Mode drop-down menu to define the accounting mode as either **Start-Stop**, **Stop Only** or **Start-Interim-Stop**. Define the interval (in seconds) used with the selected accounting mode.

9. Select the **Re-authentication** checkbox to force a periodic re-authentication with the NAC server.

   Periodic repetition of the authentication process provides ongoing security for currently authorized connections. Define an interval between 30 and 65535 seconds.

10. Refer to the **Advanced** field to define the authentication protocol used with the NAC Server.

PAP	PAP - *Password Authentication Protocol* sends a username and password over a network to a server that compares the username and password to a table of authorized users. If the username and password are matched in the table, server access is authorized.
CHAP	CHAP is an encrypted authentication method based on Microsoft's challenge/response authentication protocol.
DSCP/TOS	Optionally mark packets with a *DiffServ CodePoint* (DSCP) in its header. The DSCP value is stored in the first 6 bits of the Type of Service (ToS) field that is part of the standard IP header. The DCSP values are associated with a forwarding treatment called *Per Hop Behaviors* (PHB). Service can be provisioned (if necessary) by assigning a DCSP point code from 1 - 6.

11. Refer to the **Status** field for the current state of the requests made from applet. This field displays error messages if something goes wrong in the transaction between the applet and the switch.
12. Click **OK** to use the changes to the running configuration and close the dialog.
13. Click **Cancel** to close the dialog without committing updates to the running configuration

4.5.1.4 Configuring Different Encryption Types

To configure the WLAN data encryption options available on the switch, refer to the following:

- *Configuring WEP 64*
- *Configuring WEP 128 / KeyGuard*
- *Configuring WPA/WPA2 using TKIP and CCMP*

Configuring WEP 64

Wired Equivalent Privacy (WEP) is a security protocol specified in the *IEEE Wireless Fidelity (Wi-Fi)* standard. WEP is designed to provide a WLAN with a level of security and privacy comparable to that of a wired LAN.

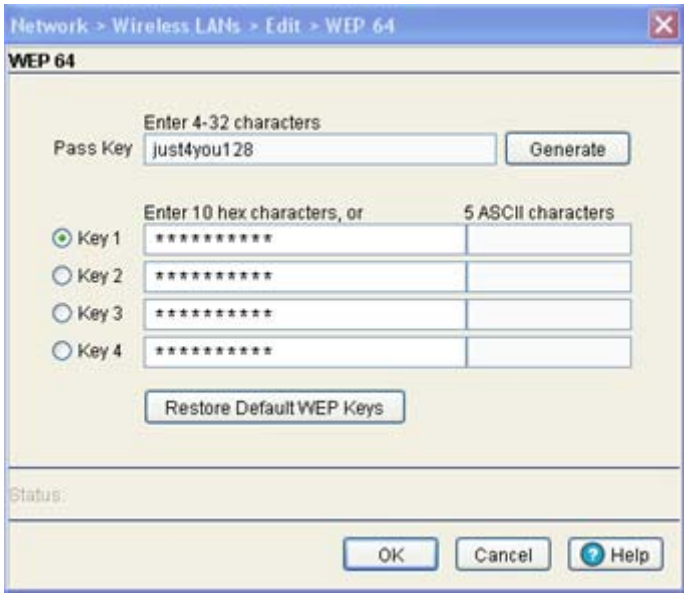
WEP 64 is a less robust encryption scheme than WEP 128 (shorter WEP algorithm for a hacker to duplicate), but WEP 64 may be all that a small-business user needs for the simple encryption of wireless data. However, networks that require more security are at risk from a WEP flaw. The existing 802.11 standard alone offers administrators no effective method to update keys.

To configure WEP 64:

1. Select **Network** > **Wireless LANs** from the main menu tree.
2. Select an existing WLAN from those displayed within the **Configuration** tab and click the **Edit** button.

   A WLAN screen displays with the WLAN's existing configuration. Refer to the **Authentication** and **Encryption** columns to assess the WLAN's existing security configuration.
3. Select the **WEP 64** button from within the Encryption field.
4. Click the **Config** button to the right of the WEP 64 checkbox.

   The **WEP 64** screen displays.



5. Specify a 4 to 32 character **Pass Key** and click the **Generate** button.

   The pass key can be any alphanumeric string. The switch, other proprietary routers and MUs use the algorithm to convert an ASCII string to the same hexadecimal number. MUs without Motorola adapters need to use WEP keys manually configured as hexadecimal numbers.

6. Use the **Key #1-4** areas to specify keys.

   The key can be either a hexadecimal or ASCII string. For WEP 64 (40-bit key), the keys are 10 hexadecimal characters in length or 5 ASCII characters. Select one of these keys for activation by clicking its radio button.

   Default (hexadecimal) keys for WEP 64 include:

Key 1	1011121314
Key 2	2021222324
Key 3	3031323334
Key 4	4041424344

7. If you feel it necessary to restore the WEP algorithm back to its default settings, click the **Restore Default WEP Keys** button. This may be the case if you feel the latest defined WEP algorithm has been compromised and no longer provides its former measure of data security.
8. Refer to the **Status** field for the current state of the requests made from applet. This field displays error messages if something goes wrong in the transaction between the applet and the switch.
9. Click **OK** to use the changes to the running configuration and close the dialog.
10. Click **Cancel** to close the dialog without committing updates to the running configuration.

Configuring WEP 128 / KeyGuard

WEP 128 provides a more robust encryption algorithm that WEP 64 by requiring a longer key length and pass key. Thus, making it harder to hack through the replication of WEP keys. WEP 128 may be all that a small-business user needs for the simple encryption of wireless data.

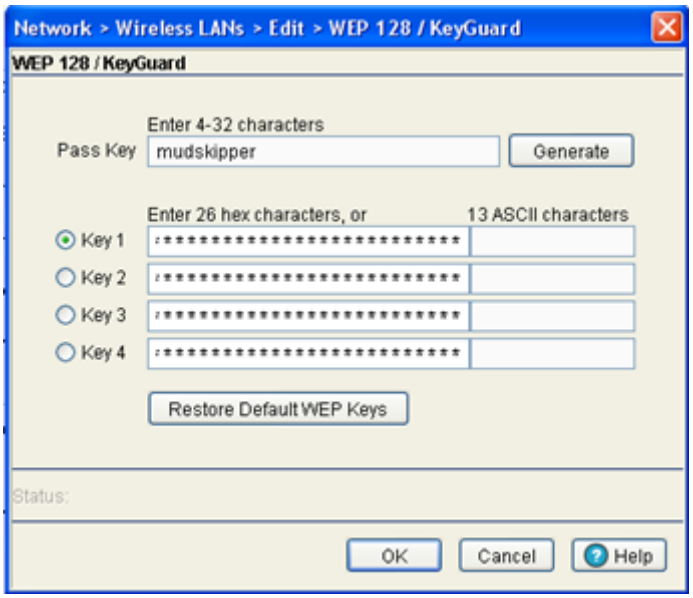
KeyGuard is a proprietary encryption method. KeyGuard is an enhancement to WEP encryption, and was developed before the finalization of WPA-TKIP. This encryption implementation is based on the IEEE Wireless Fidelity (Wi-Fi) standard, 802.11i.

To configure WEP 128 or KeyGuard:

1. Select **Network** > **Wireless LANs** from the main menu tree.
2. Select an existing WLAN from those displayed within the **Configuration** tab and click the **Edit** button.

   A WLAN screen displays with the WLAN's existing configuration. Refer to the **Authentication** and **Encryption** columns to assess the WLAN's existing security configuration.
3. Select either the **WEP 128** or **KeyGuard** button from within the Encryption field.
4. Click the **Config** button to the right of the WEP 128 and KeyGuard checkboxes.

   The **WEP 128 / KeyGuard** screen displays.



5. Specify a 4 to 32 character **Pass Key** and click the **Generate** button.

   The pass key can be any alphanumeric string. The switch and MUs use the algorithm to convert an ASCII string to the same hexadecimal number. MUs without Motorola adapters need to use WEP keys manually configured as hexadecimal numbers.

6. Use the **Key #1-4** areas to specify key numbers.

   The key can be either a hexadecimal or ASCII. The keys are 26 hexadecimal characters in length or 13 ASCII characters. Select one of these keys for activation by clicking its radio button.

   Default (hexadecimal) keys for WEP 128 and KeyGuard include:

Key 1	101112131415161718191A1B1C
Key 2	202122232425262728292A2B2C
Key 3	303132333435363738393A3B3C
Key 4	404142434445464748494A4B4C

7. If you feel it necessary to restore the WEP algorithm back to its default settings, click the **Restore Default WEP Keys** button. This may be the case if you feel the latest defined WEP algorithm has been compromised and no longer provides its former measure of data security.
8. Refer to the **Status** field for the current state of the requests made from applet. This field displays error messages if something goes wrong in the transaction between the applet and the switch.
9. Click **OK** to use the changes to the running configuration and close the dialog.
10. Click **Cancel** to close the dialog without committing updates to the running configuration.

Configuring WPA/WPA2 using TKIP and CCMP

Wi-Fi Protected Access (WPA) is a robust encryption scheme specified in the *IEEE Wireless Fidelity* (Wi-Fi) standard, 802.11i. WPA provides more sophisticated data encryption than WEP. WPA is designed for corporate networks and small-business environments where more wireless traffic allows quicker discovery of encryption keys by an unauthorized person.

WPA's encryption method is *Temporal Key Integrity Protocol (TKIP).* TKIP addresses WEP's weaknesses with a re-keying mechanism, a per-packet mixing function, a message integrity check, and an extended initialization vector. WPA also provides strong user authentication based on 802.1x EAP.

WPA2 is a newer 802.11i standard that provides even stronger wireless security than WPA and WEP. CCMP is the security standard used by the *Advanced Encryption Standard* (AES). AES serves the same function TKIP does for WPA-TKIP. CCMP computes a *Message Integrity Check* (MIC) using the proven *Cipher Block Chaining* (CBC) technique. Changing just one bit in a message produces a totally different result.

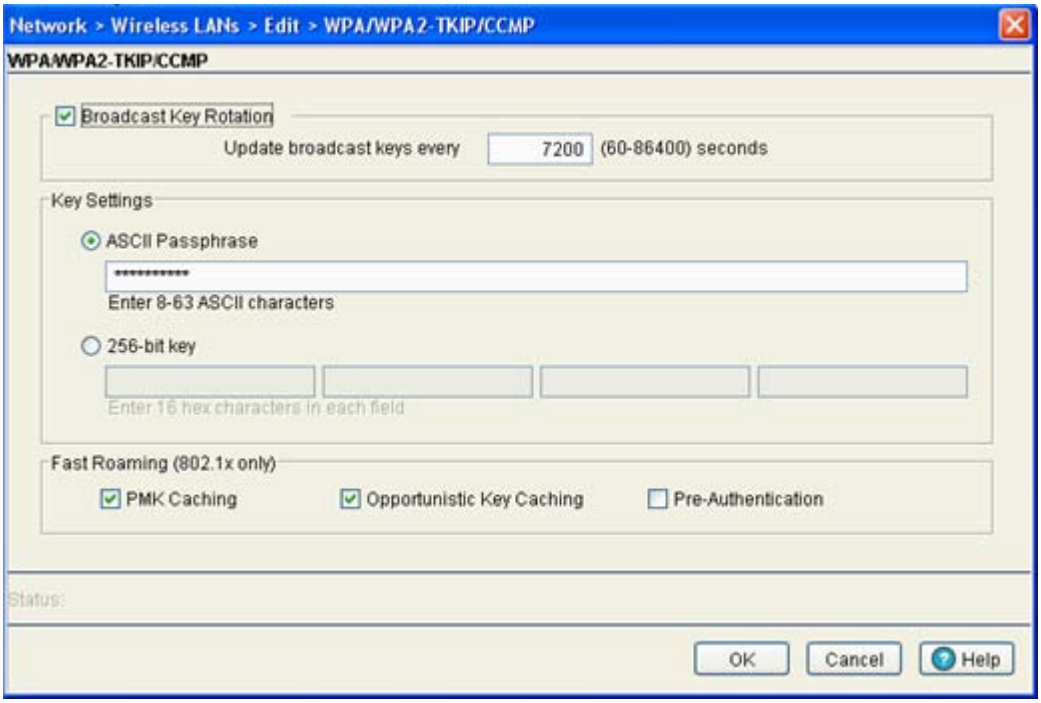
WPA2-CCMP is based on the concept of a *Robust Security Network* (RSN), which defines a hierarchy of keys with a limited lifetime (similar to TKIP). Like TKIP, the keys the administrator provides are used to derive other keys. Messages are encrypted using a 128-bit secret key and a 128-bit block of data. The end result is an encryption scheme as secure as any the switch provides.

To configure WPA/WPA2-TKIP/CCMP encryption:

1. Select **Network** > **Wireless LANs** from the main menu tree.
2. Select an existing WLAN from those displayed within the **Configuration** tab and click the **Edit** button.

   A WLAN screen displays with the WLAN's existing configuration. Refer to the **Authentication** and **Encryption** columns to assess the WLAN's existing security configuration.
3. Select either the **WPA/WPA2-TKIP** or **WPA2-CCMP** button from within the Encryption field.
4. Click the **Config** button to the right of the WPA/WPA2-TKIP and WPA2-CCMP checkboxes.

   The **WPA/WPA2-TKIP/CCMP** screen displays. This single screen can be used to configure either WPA/WPA2-TKIP or WPA-CCMP.



5. Select the **Broadcast Key Rotation** checkbox to enable the broadcast of encryption-key changes to MUs.

Only broadcast key changes when required to reduce the transmissions of sensitive key information. This value is enabled by default.

6. Refer to the **Update broadcast keys every** field to specify a time period (in seconds) for broadcasting encryption-key changes to MUs.

   Set key broadcasts to a shorter interval (at least 60 seconds) for tighter security on wireless connections. Set key broadcasts to a longer interval (at most, 86400 seconds) to extend key times for wireless connections. The default is 7200 seconds.

7. Configure the **Key Settings** field as needed to set an ASCII Passphrase and key values.

ASCII Passphrase	To use an ASCII passphrase (and not a hexadecimal value), select the checkbox and enter an alphanumeric string of 8 to 63 characters. The alphanumeric string allows character spaces. The switch converts the string to a numeric value. This passphrase saves the administrator from entering the 256-bit key each time keys are generated.
256-bit Key	To use a hexadecimal value (and not an ASCII passphrase), select the checkbox and enter 16 hexadecimal characters into each of the four fields displayed.

   Default (hexadecimal) 256-bit keys for WPA/TKIP include:

   - *1011121314151617*
   - *18191A1B1C1D1E1F*
   - *2021222324252627*
   - *28292A2B2C2D2E2F*

8. Optionally select one of the following from within the **Fast Roaming (8021x only)** field.

PMK Caching	Select *Pairwise Master Key* (PMK) caching to create a shared key between a client device and its authenticator. When a client roams between devices, the client's credentials no longer need to completely reauthenticated (a process that can take up to 100 milliseconds). In the instance of a voice session, the connection would likely be terminated if not using a PMK. PMK cache entries are stored for a finite amount of time, as configured on the wireless client.
Opportunistic Key Caching	**Opportunistic Key Caching** allows the switch to use a PMK derived with a client on one access port with the same client when it roams over to another access port. Upon roaming, the client does not have to conduct 802.1x authentication and can start sending/receiving data sooner.
Pre-Authentication	Selecting the **Pre-Authentication** option enables an associated MU to carry out an 802.1x authentication with another switch (or device) before it roams to it. This enables the roaming client to send and receive data sooner by not having to conduct an 802.1x authentication after roaming. This is only supported when 802.1x EAP authentication is enabled.

9. Refer to the **Status** field for the current state of the requests made from applet. This field displays error messages if something goes wrong in the transaction between the applet and the switch.

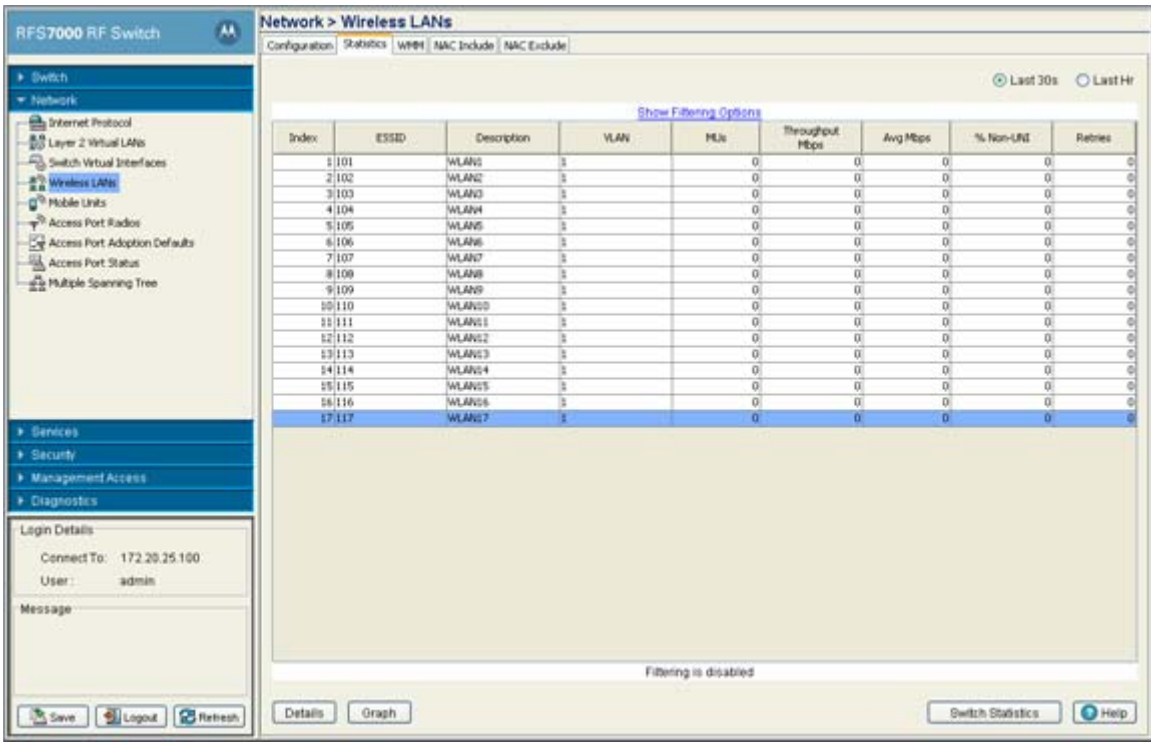
10. Click **OK** to use the changes to the running configuration and close the dialog.
11. Click **Cancel** to close the dialog without committing updates to the running configuration.

4.5.2 Viewing WLAN Statistics

The **Statistics** screen displays read-only statistics for each WLAN. Use this information to assess if configuration changes are required to improve network performance. If a more detailed set of WLAN statistics is required, select a WLAN from the table and click the **Details** button.

To view WLAN configuration details:

1. Select **Network** > **Wireless LANs** from the main menu tree.
2. Click the **Statistics** tab.



3. Refer to the following details displayed within the table:

Last 30s	Click the Last 30s radio button to display statistics for the WLAN over the last 30 seconds. This option is helpful when troubleshooting issues as they actually occur.
Last Hr	Click the Last Hr radio button to displays statistics for the WLAN over the last 1 hour. This metric is helpful in baselining events over a one hour interval.
Index	The Idx (or index) is a numerical identifier used to differentiate the WLAN from other WLANs that may have similar characteristics.
ESSID	The SSID is the *Service Set ID* (SSID) for the selected WLAN.
Description	The Description item contains a brief description of the WLAN. Use the description (along with the index) to differentiate the WLAN from others with similar attributes.

VLAN	The VLAN parameter displays the name of the VLAN the WLAN is associated with.
MUs	Lists the number of MUs associated with the WLAN.
Throughput Mbps	Throughput Mbps is the average throughput in Mbps on the selected WLAN. The Rx value is the average throughput in Mbps for packets received on the selected WLAN. The Tx value is the average throughput for packets sent on the selected WLAN.
Avg Mbps	Displays the average bit speed in Mbps for the selected WLAN. This includes all packets sent and received.
% Non-UNI	Displays the percentage of the total packets for the selected WLAN that are non-unicast packets. Non-unicast packets include broadcast and multicast packets.
Retries	Displays the average number of retries for all MUs associated with the selected WLAN.

4. To view WLAN statistics in greater detail, select a WLAN and click the **Statistics** button. For more information, see *Viewing WLAN Statistics Details on page 4-56*.
5. To view WLAN statistics in a graphical format, select a WLAN and click the **Graph** button. For more information, see *Viewing WLAN Statistics in a Graphical Format on page 4-59*.
6. To view WLAN packet data rates and retry counts, select a WLAN and click the **Switch Statistics** button. For more information, see *Viewing WLAN Switch Statistics on page 4-60*.

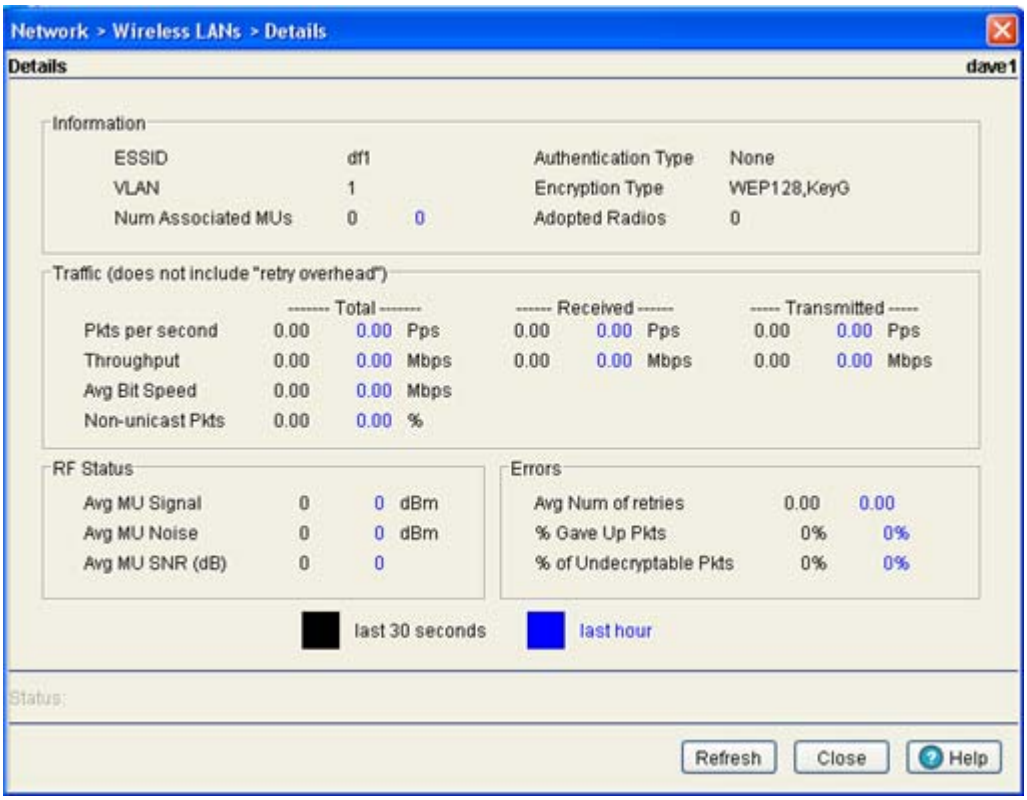
4.5.2.1 Viewing WLAN Statistics Details

When the WLAN Statistics screen does not supply adequate information for an individual WLAN, the **Details** screen is recommended for displaying more granular information for a single WLAN. Use this information to discern if a WLAN requires modification to meet network expectations.

To view detailed statistics for a WLAN:

1. Select a **Network** > **Wireless LANs** from the main menu tree.
2. Click the **Statistics** tab.

3. Select a WLAN from the table displayed in the Statistics screen and click the **Details** button.



The Details screen displays the WLAN statistics of the selected WLAN. The Details screen contains the following fields:

- *Information*
- *Traffic*
- *RF Status*
- *Errors*

Information in black represents the statistics from the last 30 seconds and information in blue represents statistics from the last hour.

4. Refer to the **Information** field for the following:

ESSID	Displays the *Service Set ID* (SSID) for the selected WLAN.
VLAN	Displays the name of the VLAN the WLAN is associated with.
Num Associated Stations	Displays the total number of MUs currently associated with the selected WLAN.
Authentication Type	Displays the authentication method deployed on the WLAN.
Encryption Type	Displays the encryption type deployed on the selected WLAN.
Adopted Radios	Displays the radios adopted by the selected WLAN.

5. Refer to the **Traffic** field for the following information (both received and transmitted):

Pkts per second	Displays the average total packets per second that cross the selected WLAN. The Rx column displays the average total packets per second received on the selected WLAN. The Tx column displays the average total packets per second sent on the selected WLAN. The number in black represents this statistic for the last 30 seconds and the number in blue represents this statistic for the last hour.
Throughput	Displays the average throughput in Mbps on the selected WLAN. The Rx column displays the average throughput in Mbps for packets received on the selected WLAN. The Tx column displays the average throughput for packets sent on the selected WLAN. The number in black represents this statistic for the last 30 seconds and the number in blue represents this statistic for the last hour.
Avg Bit Speed	Displays the average bit speed in Mbps on the selected WLAN. This includes all packets sent and received. The number in black represents this statistic for the last 30 seconds and the number in blue represents this statistic for the last hour.
Non-unicast Pkts	Displays the percentage of the total packets for the selected WLAN that are non-unicast. Non-unicast packets include broadcast and multicast packets. The number in black represents this statistic for the last 30 seconds and the number in blue represents this statistic for the last hour.

6. Refer to the **RF Status** field for the following information:

Avg MU Signal	Displays the average RF signal strength in dBm for all MUs associated with the selected WLAN. The number in black represents this statistic for the last 30 seconds and the number in blue represents this statistic for the last hour.
Avg MU Noise	Displays the average RF noise for all MUs associated with the selected WLAN. The number in black represents this statistic for the last 30 seconds and the number in blue represents this statistic for the last hour.
Avg MU SNR (dB)	Displays the average *Signal to Noise Ratio* (SNR) for all MUs associated with the selected WLAN. The Signal to Noise Ratio is an indication of overall RF performance on your wireless network.

7. Refer to the **Errors** field for the following information:

Average Number of Retries	Displays the average number of retries for all MUs associated with the selected WLAN. The number in black represents this statistic for the last 30 seconds and the number in blue represents this statistic for the last hour.
% Gave Up Pkts	Displays the percentage of packets the switch gave up on for all MUs associated with the selected WLAN. The number in black represents this statistic for the last 30 seconds and the number in blue represents this statistic for the last hour.
% Undecryptable Pkts	Displays the percentage of undecryptable packets for all MUs associated with the selected WLAN. The number in black represents this statistic for the last 30 seconds and the number in blue represents this statistic for the last hour.

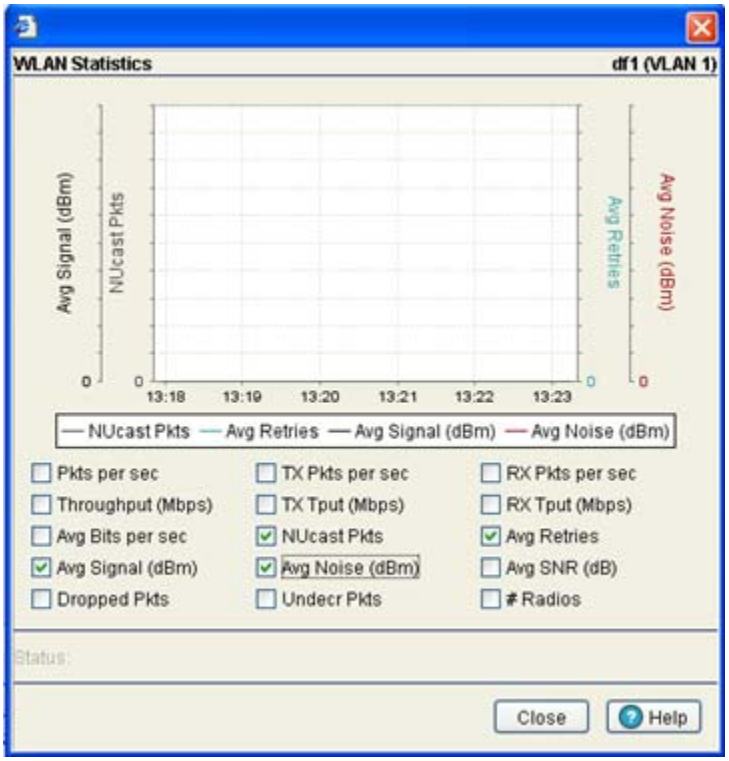
8. Refer to the **Status** field for the current state of the requests made from applet. This field displays error messages if something goes wrong in the transaction between the applet and the switch.
9. Click **OK** to use the changes to the running configuration and close the dialog.
10. Click **Cancel** to close the dialog without committing updates to the running configuration.

4.5.2.2 Viewing WLAN Statistics in a Graphical Format

The switch Web UI continuously collects WLAN statistics even when the graph is not displayed. Periodically display the WLAN statistics graph for the latest WLAN throughput and performance information.

To view detailed graphical statistics for a WLAN:

1. Select a WLAN from the table displayed in the **Statistics** screen.
2. Click the **Graph** button.



The WLAN Statistics screen displays for the select port. The WLAN Statistics screen provides the option of viewing the graphical statistics of the following parameters:

- *Pkts per sec*
- *Throughput (Mbps)*
- *Avg Bits per sec*
- *Avg Signal (dBm)*
- *Dropped Pkts*
- *TX Pkts per sec*
- *TX Tput (Mbps)*
- *NUcast Pkts*
- *Avg Noise (dBm)*

- *Undecr Pkts*
- *RXPkts per sec*
- *RX Tput (Mbps)*
- *Avg Retries*
- *Avg SNR (dB)*
- *# Radios*

NOTE You cannot select (and trend) more than four parameters at any given time.

3. Select any of the above listed parameters by clicking on the checkbox associated with it.
4. Click the **Close** button to exit the screen.

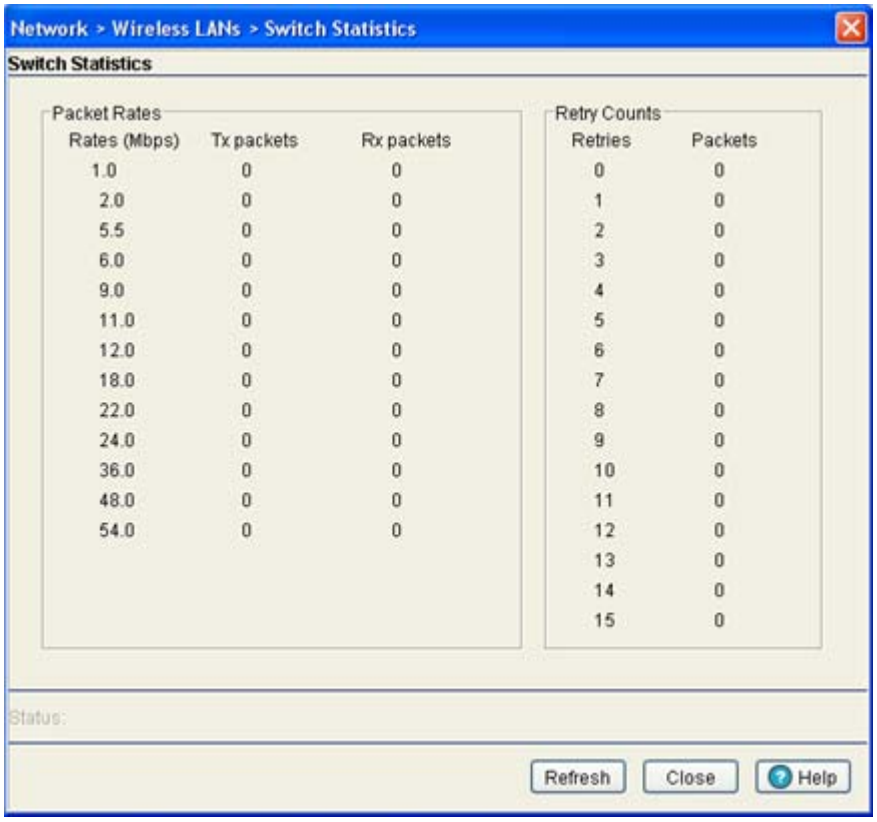
4.5.2.3 Viewing WLAN Switch Statistics

The **Switch Statistics** screen is recommended for displaying individual WLAN packet data rate and retry information. The Switch Statistics screen is optimal for determining whether data traffic within each WLAN meets its intended throughput speed based on the WLAN's MU traffic requirements. Use this information to discern if WLAN's require modification to meet network throughput expectations.

To view detailed statistics for a WLAN:

1. Select a **Network** > **Wireless LANs** from the main menu tree.
2. Click the **Statistics** tab.

3. Select a WLAN from the table displayed in the Statistics screen and click the **Switch Statistics** button.



4. Refer to the **Packet Rates** field to review the number of packets both transmitted (Tx) and received (Rx) at data rates from 1.0 to 54.0 Mbps. If a large number of packets are sent and received at a slower data rate, then perhaps the switch is not adequately positioned or configured to support the MUs within that WLAN.

NOTE The *Motorola RF Management Software* is recommended to plan the deployment of the switch. Motorola RFMS can help optimize the positioning and configuration of a switch in respect to a WLAN's MU throughput requirements. For more information, refer to the Motorola Web site.

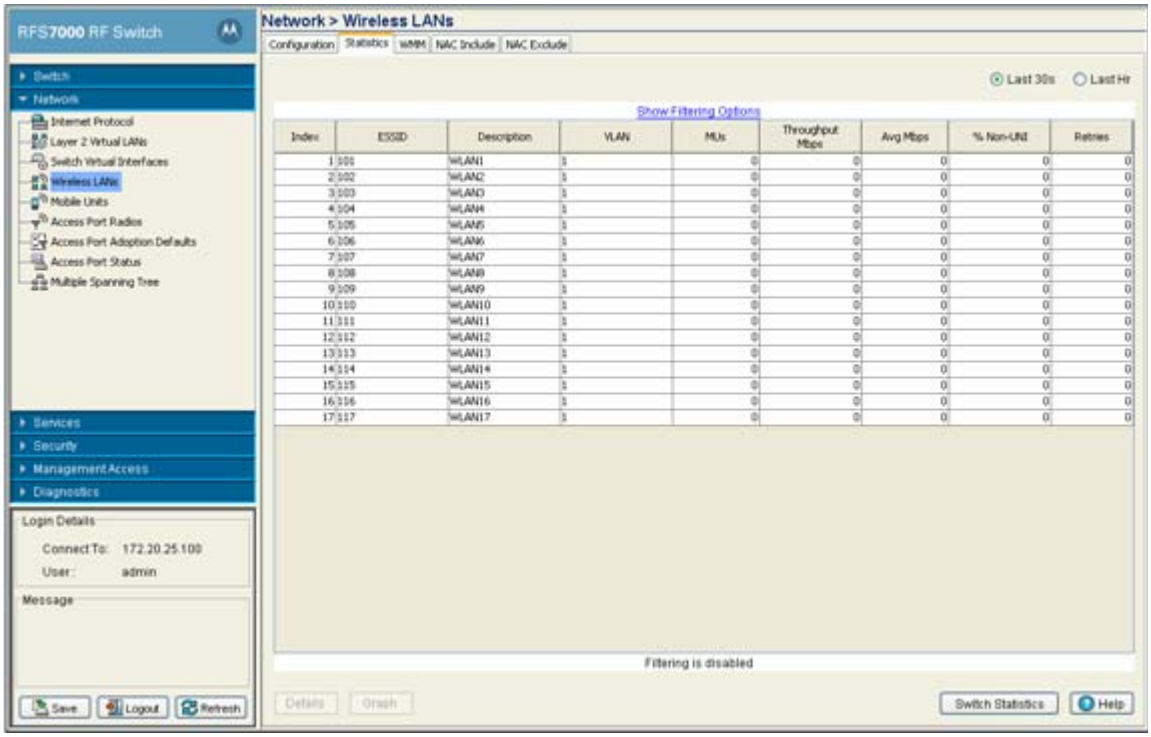
5. Refer to the **Retry Counts** field to review the number packets requiring retransmission from the switch.
6. Refer to the **Status** field for the current state of the requests made from applet. This field displays error messages if something goes wrong in the transaction between the applet and the switch.
7. Click **Refresh** to update the Packet Rate and Retry Count data displayed within the screen.
8. Click **Close** to close the dialog and re turn to the Network > Wireless LANs > Statistics screen.

4.5.3 Configuring WMM

Use the **WMM** tab to review a WLAN's current index (numerical identifier), SSID, description, current enabled/disabled designation, and Access Category. WMM is for downstream and WLAN WMM is for upstream data traffic.

To view existing WMM settings:

1. Select **Network** > **Wireless LANs** from the main menu tree.
2. Click the **WMM** tab.

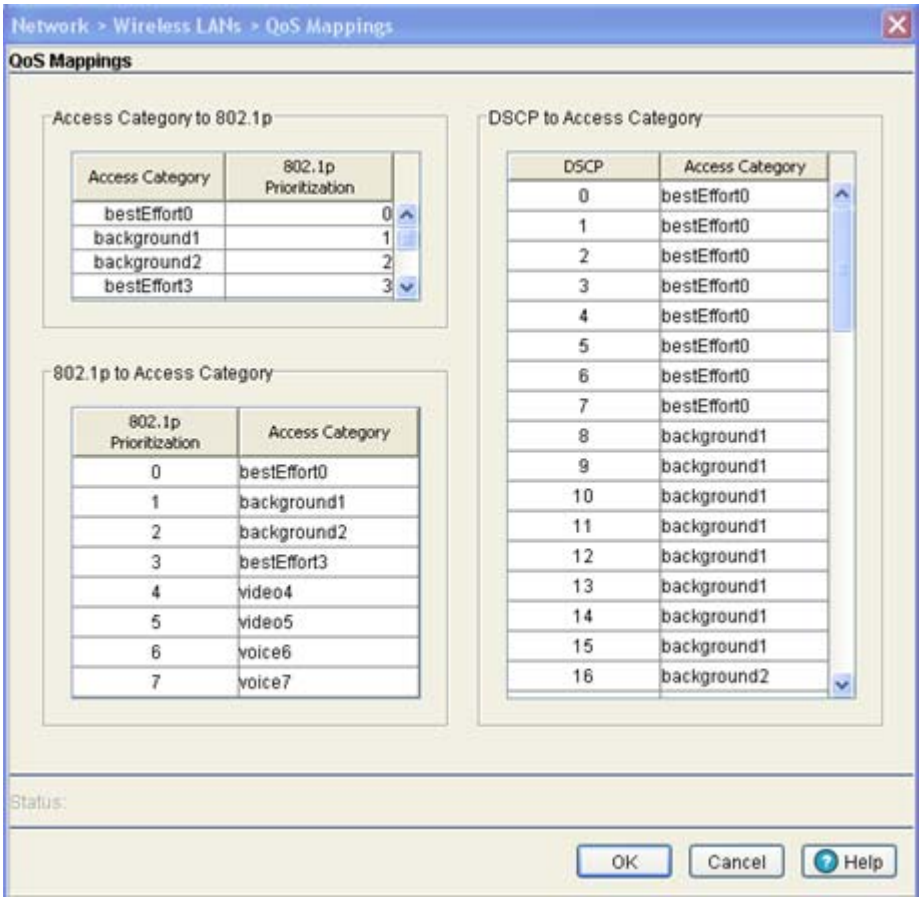


The **WMM** tab displays the following information:

Idx	Displays a WLAN's numeric identifier. The WLAN index range is from 1 to 256.
SSID	Displays the *Service Set ID* (SSID) associated with each WLAN.
Description	Displays a brief description of the WLAN.
WLAN enabled	Displays the status of the WLAN. A Green check defines the WLAN as enabled and a Red "X" means it is disabled. The enable/disable setting can be defined using the WLAN Configuration screen.
WMM enabled	Displays WLAN-WMM status. It can be enabled (for a WLAN) from the WLAN Configurations Edit screen by selecting the Enable WMM checkbox.
Access	Displays the Access Category for the intended radio traffic. Access Categories are the different WLAN-WMM options available. The four Access Categories are: • *Best-effort* — Optimized for best effort traffic • *Background* — Optimized for background traffic • *Video* — Optimized for video traffic • *Voice* — Optimized for voice traffic
AIFSN	Displays the current *Arbitrary Inter-frame Space Number* (AIFSN). Higher-priority traffic categories should have lower AIFSNs than lower-priority traffic categories. This will causes lower-priority traffic to wait longer before trying attempting access.

Transmit Ops	Displays the maximum duration a device can transmit after obtaining a transmit opportunity. For higher-priority traffic categories, this value should be set to a low number.
CW Min	The CW Min is combined with the CW Max to make the Contention screen. From this range, a random number is selected for the back off mechanism. Lower values are used for higher priority traffic.
CW Max	The CW Max is combined with the CW Min to make the Contention screen. From this range, a random number is selected for the back off mechanism. Lower values are used for higher priority traffic.

3. Click the **Edit** button to display a screen used to modify existing WMM parameters. For more information, see *Editing WMM Setting on page 4-65*.
4. Select the **QoS Mappings** button to revise the existing mappings of access category to 802.1p and DSCP to access category settings.



With a drastic increase in bandwidth absorbing traffic (VOIP, multimedia etc.), the importance of data prioritization is central to effective network management.

Refer to the following fields within the QoS Mapping screen to optionally revise existing settings in respect to the data traffic requirements for each WLAN.

Access Category to 802.1p	Optionally revise the **802.1p Prioritization** for each access category to prioritize the network traffic expected on this WLAN.
802.1p to Access Category	Set the access category accordingly in respect to its importance for this WLAN's target network traffic.

DSCP to Access Category	Set the access category accordingly in respect to its DSCP importance for this WLAN's target network traffic. *Differentiated Services Code Point* (DSCP) is a field in an IP packet that enables different levels of service to be assigned to network traffic. This is achieved by marking each packet on the network with a DSCP code and appropriating to it the corresponding level of service or priority. QoS enabled programs request a specific service type for a traffic flow through the generic QoS (GQoS) application programming interface (API).

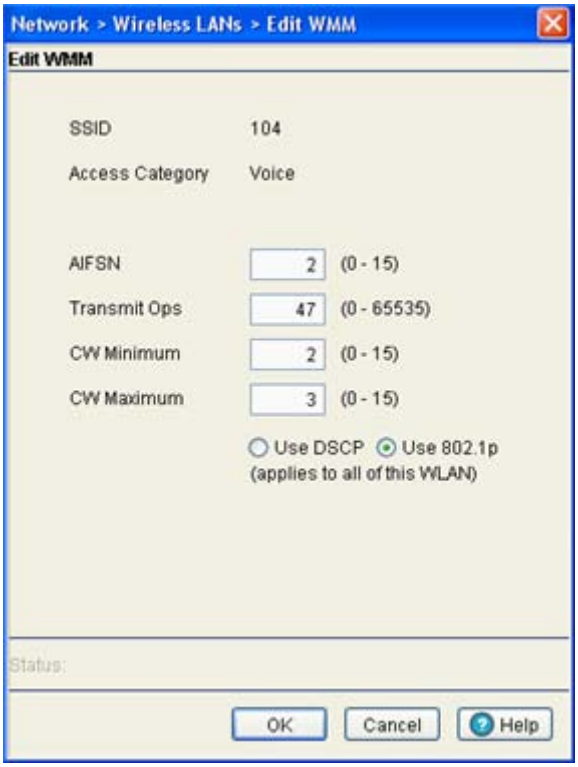
5. Click **OK** to save the updates to the QoS mappings.
6. Select **Cancel** to close the screen without updating the configuration.

4.5.3.1 Editing WMM Setting

Use the WMM Edit screen to modify existing Access Category settings for the WLAN selected within the WMM screen. This could be necessary in instances when data traffic has changed and high-priority traffic (video and voice) must be accounted for by modifying AIFSN Transmit Ops and CW values.

To edit existing WMM Settings:

1. Select **Network > WLAN Setup** from the main menu tree.
2. Click the **WMM** tab.
3. Select a Access Category from the table and click the **Edit** button to launch a dialog with WMM configuration for that radio.



4. Refer to the **Edit WMM** screen for the following information:

SSID — Displays the *Service Set ID* (SSID) associated with the selected WMM index. This SSID is read-only and cannot be modified within this screen.

Access Category — Displays the Access Category for the intended radio traffic. The Access Categories are the different WLAN-WMM options available to the radio.

The four Access Category types are:

- *Background* - Optimized for background traffic
- *Best-effort* - Optimized for best effort traffic
- *Video* - Optimized for video traffic
- *Voice* - Optimized for voice traffic

AIFSN	Define the current *Arbitrary Inter-frame Space Number* (AIFSN). Higher-priority traffic categories should have lower AIFSNs than lower-priority traffic categories. This will causes lower-priority traffic to wait longer before trying to access the medium.
Transmit Ops	Define the maximum duration a device can transmit after obtaining a transmit opportunity. For higher-priority traffic categories, this value should be set to a low number.
CW Minimum	The CW Minimum is combined with the CW Maximum to make the Contention screen. From this range, a random number is selected for the back off mechanism. Select a lower value for high priority traffic.
CW Maximum	The CW Maximum is combined with the CW Minimum to make the Contention screen. From this range, a random number is selected for the back off mechanism. Lower values are used for higher priority traffic
Use DSCP or 802.1p	Select the DSCP or 802.1p radio buttons to choose between DSCP and 802.1p.

5. Refer to the **Status** field for the current state of the requests made from applet. This field displays error messages if something goes wrong in the transaction between the applet and the switch.
6. Click **OK** to use the changes to the running configuration and close the dialog.
7. Click **Cancel** to close the dialog without committing updates to the running configuration.

4.5.4 Configuring the NAC Inclusion List

Using NAC, the switch acts as an enforcement entity before allowing MU access to specific network resources. NAC performs a MU host integrity check wherein a MU sends host integrity information to the NAC server. The NAC server configuration is defined on the switch on a per WLAN basis. NAC verifies a MU's compliance with the NAC server's security policy (not the switch).

For a NAC configuration example using the switch CLI, see *NAC Configuration Examples Using the Switch CLI on page 4-73*.

An include list is a list of MAC addresses configured for a WLAN. During EAP authentication, the EAP server (Radius or NAC server) is determined based on the MU's MAC address.

- All non-802.1x devices are partitioned into a WLAN (separate from a 802.1x enabled WLAN).
- Communication between devices in a 802.1x supported WLAN and a non 802.1x supported WLAN is achieved by merging the WLANs within the same VLAN.

The switch uses the include list to add devices that are NAC supported. The following explains how authentication is achieved using 802.1x. The switch authenticates 802.1x enabled devices using one of the following:

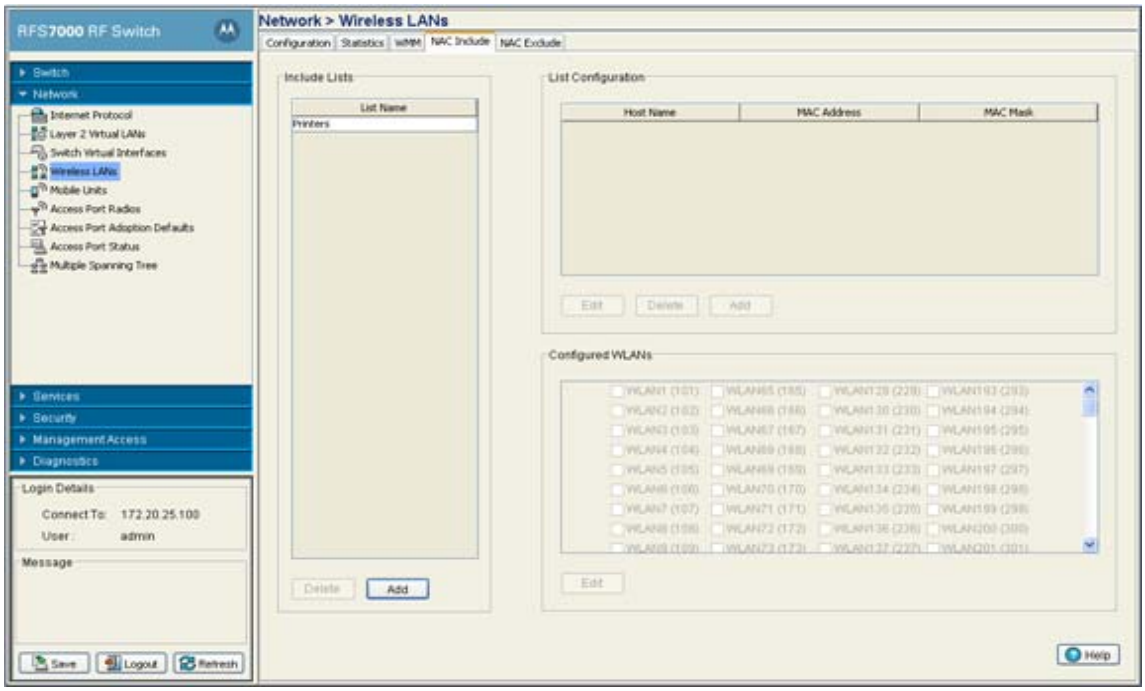
- *NAC Agent* – NAC support is added in the switch to allow the switch to communicate with a LAN enforcer (a laptop with a NAC agent installed).
- *No NAC Agent* – NAC support is achieved using an exclude list. For more information, see *Configuring the NAC Exclusion List on page 4-70*.

By default, a WLAN is NAC disabled. Each WLAN can be configured to:

- Conduct a NAC check for MU's connecting to the WLAN as well as perform an additional exclude function, by attaching an exclude list to the WLAN.
- Not perform NAC validation for all MUs connecting to the WLAN.
- Include a few MU's for NAC validation and bypass the rest of the MU's.

To view the attributes of a NAC Inclusion list:

1. Select **Network** > **Wireless LANs** from the main menu tree.
2. Select the **NAC Include List Configuration** tab to view and configure NAC enabled devices.



3. The **Include Lists** field displays devices that can be included on a WLAN (a printer for example).

   Use the **Add** button to add a device for configuration on a WLAN. A maximum of 6 MAC addressees are allowed per device. For more information, see *Adding an Include List to a WLAN on page 4-68*.

   The **List Configuration** field displays a list of MAC addresses available on a WLAN. You can add more than one device in the list. For example, printer 1, printer 2 etc.

4. Select the **Add** button (within the **List Configuration** field) to add additional devices to the WLAN. You can create up to 32 lists (both include and exclude combined together) with a maximum 64 MAC entries per list. For more information, see *Configuring Devices on the Include List on page 4-68*.
5. The **Configured WLANs** field displays available WLANs. Associate a list item (within the Include Lists field) with as many WLANs as required.

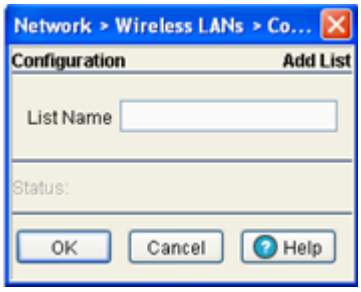
   For information on mapping NAC Include list items with WLANs, see *Mapping Include List Items to WLANs on page 4-69*.

6. To delete a device (and its configuration), select it from the **Include Lists** and click the **Delete** button.
7. Use the **Edit** button in the **List Configuration** section to modify the devices parameters.
8. To delete any list configuration for a particular device, select the row from the **List Configuration** section and click on the **Delete** button.

4.5.4.1 Adding an Include List to a WLAN

To add a device to a WLAN's include list configuration:

1. Select **Network** > **Wireless LANs** from the main menu tree.
2. Select the **NAC Include** tab to view and configure NAC Include enabled devices.
3. Click on the **Add** button in the **Include Lists** area.



4. Enter the name of the device to include for NAC authentication.
5. Refer to the **Status** field. It displays the current state of the requests made from the applet. Requests are any "SET/GET" operation from the applet. The Status field displays error messages if something goes wrong in the transaction between the applet and the switch.
6. Click **OK** to save the new configuration and close the dialog window.
7. Click **Cancel** to close the dialog without committing updates to the running configuration.

4.5.4.2 Configuring Devices on the Include List

To add a multiple number of devices for a single device type:

1. Select **Network** > **Wireless LANs** from the main menu tree.
2. Select the **NAC Include** tab to view and configure all the NAC Include enabled devices.
3. Click on the **Add** button within the **List Configuration** area.

The **List Name** field displays the name of the device list used. This parameter is read-only.

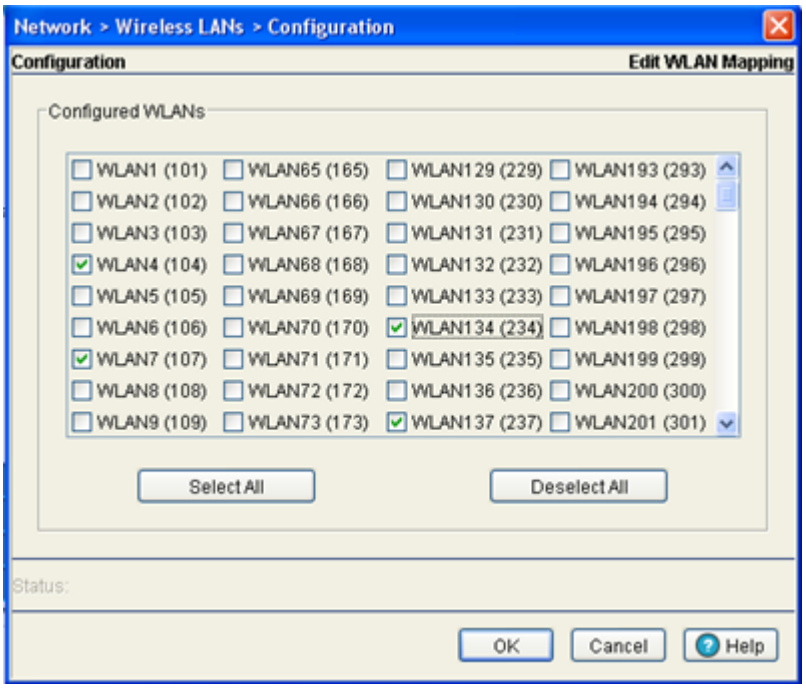
4. Enter the **Host Name** for the added device.
5. Enter the device's **MAC Address**.
6. Optionally, enter the **MAC Mask** for the device you wish to add.

7. Refer to the **Status** field. It displays the current state of the requests made from the applet. Requests are any "SET/GET" operation from the applet. The Status field displays error messages if something goes wrong in the transaction between the applet and the switch.
8. Click **OK** to save and add the new configuration and close the dialog window.
9. Click **Cancel** to close the dialog without committing updates to the running configuration.

4.5.4.3 Mapping Include List Items to WLANs

To assign include list items to a one or more WLANs:

1. Select **Network** > **Wireless LANs** from the main menu tree.
2. Select the **NAC Include** tab to view NAC Included devices.
3. Select an item from the Include List's **List Name** field and click the **Edit** button (within the **Configured WLANs** field).


Network > Wireless LANs > Configuration
Configuration
Edit WLAN Mapping
Configured WLANs
WLAN1 (101) WLAN65 (165) WLAN129 (229) WLAN193 (293)
WLAN2 (102) WLAN66 (166) WLAN130 (230) WLAN194 (294)
WLAN3 (103) WLAN67 (167) WLAN131 (231) WLAN195 (295)
WLAN4 (104) WLAN68 (168) WLAN132 (232) WLAN196 (296)
WLAN5 (105) WLAN69 (169) WLAN133 (233) WLAN197 (297)
WLAN6 (106) WLAN70 (170) WLAN134 (234) WLAN198 (298)
WLAN7 (107) WLAN71 (171) WLAN135 (235) WLAN199 (299)
WLAN8 (108) WLAN72 (172) WLAN136 (236) WLAN200 (300)
WLAN9 (109) WLAN73 (173) WLAN137 (237) WLAN201 (301)
Select All
Deselect All
Status:
OK
Cancel
Help

4. Map the selected list item with as many WLANs as needed (be selecting the WLAN's checkbox). Use the **Select All** button to associate each WLAN with the selected list item.
5. To remove the WLAN Mappings, select the **Deselect All** button to clear the mappings.
6. Refer to the **Status** field for a display of the current state of the requests made from the applet. Requests are any "SET/GET" operation from the applet. The Status field displays error messages if something goes wrong in the transaction between the applet and the switch.
7. Click **OK** to save and add the new configuration and close the dialog window.
8. Click **Cancel** to close the dialog without committing updates to the running configuration.

4.5.5 Configuring the NAC Exclusion List

The switch provides a means to bypass NAC for 802.1x devices without a NAC agent. For Motorola handheld devices (like the MC9000), authentication is achieved using an exclusion list.

A list of MAC addresses (called an exclusion list) can be added to each WLAN. Each has a separate configuration for the Radius server (which only conducts EAP authentication). An exclusion list is a global index-based configuration. An exclusion list can be configured and associated to any WLAN.

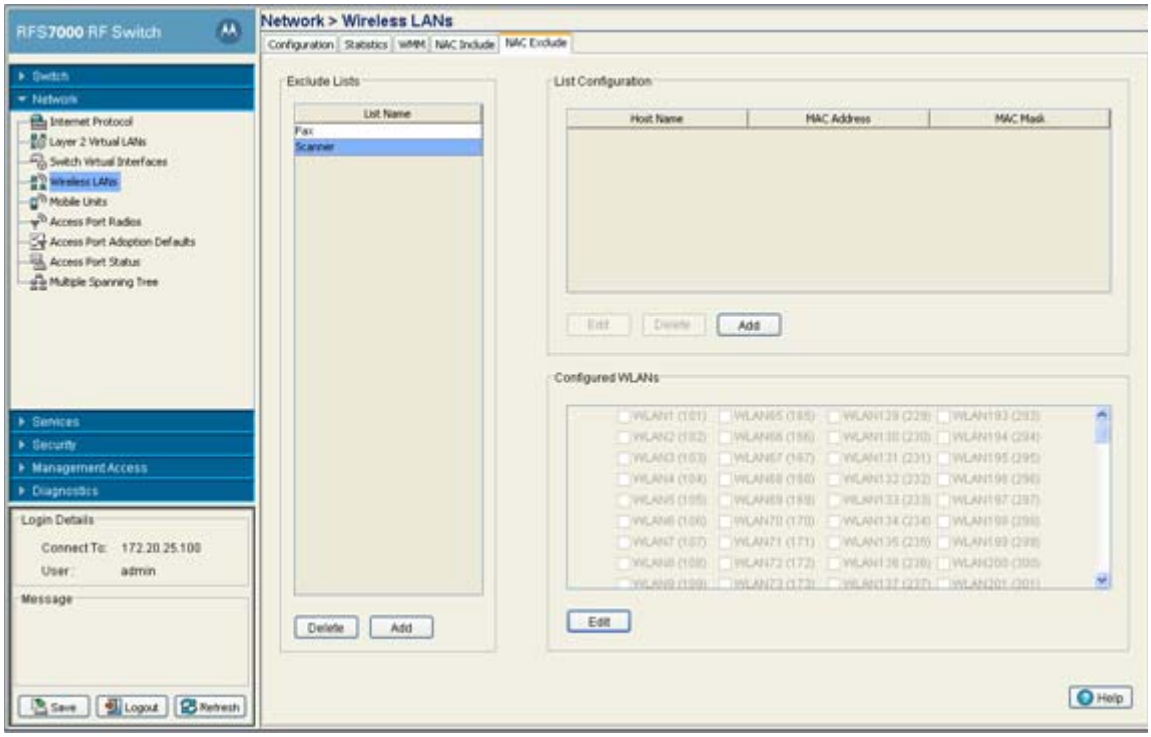
If a device's MAC address is not present in an exclusion list, it will go through the NAC server (LAN enforcer) and thereby a 802.1x host integrity check. For every WLAN configuration, there are two separate EAP servers (Radius and NAC).

Whenever a host entry is added or deleted from/to the list, the associated WLAN is updated and deauthenticated. The de-authenticated MU can be re-authenticated once it receives the de-authentication information from the WLAN.

For a NAC configuration example using the switch CLI, see *NAC Configuration Examples Using the Switch CLI on page 4-73*.

To view the attributes of a NAC exclusion list:

1. Select **Network** > **Wireless LANs** from the main menu tree.
2. Select the **NAC Exclude** tab to view and configure all the NAC include enabled devices.



The **Exclude Lists** field displays a list of devices that can be excluded from a WLAN.

3. Use the **Add** button to add a device that can be excluded on a WLAN. For more information, see *Adding an Exclude List to the WLAN on page 4-71*.

   The **List Configuration** field displays a list of MAC addresses that can be excluded from a WLAN. You can add more than one device to this list.

4. Use the **Add** button (within the **List Configuration field)** to add devices excluded from NAC compliance on a WLAN. You can create up to 32 lists (both include and exclude combined together)

and 64 MAC entries maximum per list. For more information, see *Configuring Devices on the Exclude List on page 4-71*.

5. The **Configured WLANs** field displays the available switch WLANs. Associate a list item in the Exclude Lists field with multiple WLANs.

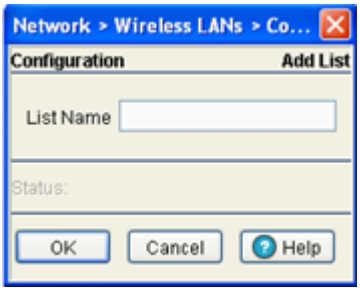
   For information on mapping NAC Exclude list's items to WLANs, see *Mapping Include List Items to WLANs on page 4-69*.

6. To delete a device, select it from the **Exclude List** and click the **Delete** button.
7. Use the **Edit** button (within the **List Configuration** field) to modify devices parameters.
8. To delete a list configuration for a device, select a row from the **List Configuration** field and click the **Delete** button.

4.5.5.1 Adding an Exclude List to the WLAN

To exclude a device from a WLAN:

1. Select **Network** > **Wireless LANs** from the main menu tree.
2. Select the **NAC Exclude** tab to view NAC exclude devices.
3. Click the **Add** button in the **Exclude Lists** field.



4. Enter the name of the device you wish to exclude for NAC authentication.
5. Refer to the **Status** field. It displays the current state of the requests made from the applet. Requests are any "SET/GET" operation from the applet. The Status field displays error messages if something goes wrong in the transaction between the applet and the switch.
6. Click **OK** to save and add the new configuration and close the dialog window.
7. Click **Cancel** to close the dialog without committing updates to the running configuration.

4.5.5.2 Configuring Devices on the Exclude List

To add more than one device for a particular type of device in the include list:

1. Select **Network > Wireless LANs** from the main menu tree.
2. Select the **NAC Exclude** tab to view and configure all the NAC exclude devices.

3. Click on the **Add** button within the **List Configuration** field.

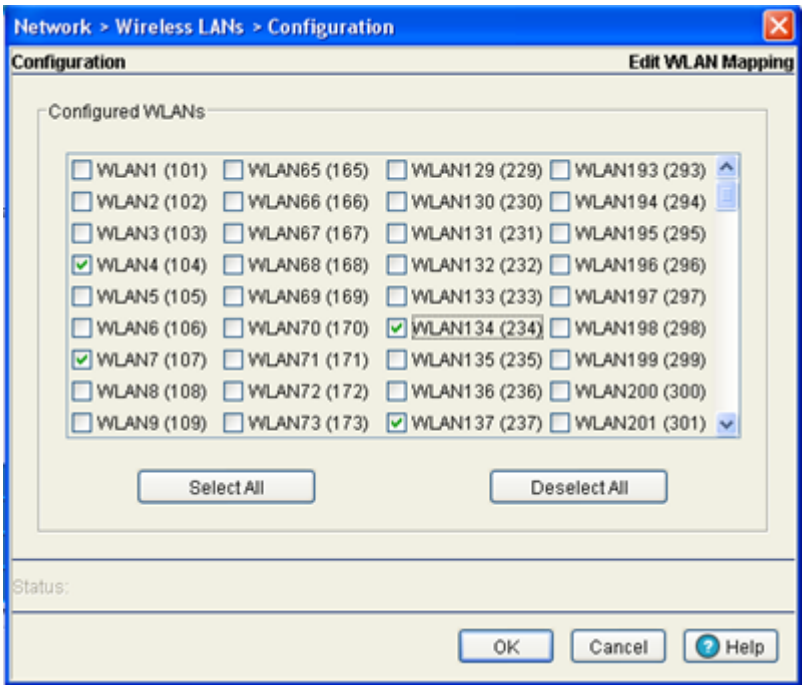
4. The **List Name** displays the read-only name of the list for which you wish to add more devices.
5. Enter the **Host Name** for the device you wish to add for the selected exclude list.
6. Enter a valid **MAC Address** for the device that you wish to add.
7. Optionally, enter the **MAC Mask** for the device you wish to add.
8. Refer to the **Status** field. It displays the current state of the requests made from the applet. Requests are any "SET/GET" operation from the applet. The Status field displays error messages if something goes wrong in the transaction between the applet and the switch.
9. Click **OK** to save and add the new configuration and close the dialog window.
10. Click **Cancel** to close the dialog without committing updates to the running configuration.

4.5.5.3 Mapping Exclude List Items to WLANs

To assign exclude list items to a one or more WLANs:

1. Select **Network** > **Wireless LANs** from the main menu tree.
2. Select the **NAC Exclude** tab to view NAC excluded devices.

3. Select a item from the Exclude List's **List Name** field and click the **Edit** button (within the **Configured WLANs** field).


Network > Wireless LANs > Configuration
Configuration
Edit WLAN Mapping
Configured WLANs
WLAN1 (101) WLAN65 (165) WLAN129 (229) WLAN193 (293)
WLAN2 (102) WLAN66 (166) WLAN130 (230) WLAN194 (294)
WLAN3 (103) WLAN67 (167) WLAN131 (231) WLAN195 (295)
WLAN4 (104) WLAN68 (168) WLAN132 (232) WLAN196 (296)
WLAN5 (105) WLAN69 (169) WLAN133 (233) WLAN197 (297)
WLAN6 (106) WLAN70 (170) WLAN134 (234) WLAN198 (298)
WLAN7 (107) WLAN71 (171) WLAN135 (235) WLAN199 (299)
WLAN8 (108) WLAN72 (172) WLAN136 (236) WLAN200 (300)
WLAN9 (109) WLAN73 (173) WLAN137 (237) WLAN201 (301)
Select All
Deselect All
Status:
OK
Cancel
Help

4. Map the selected list item with as many WLANs as needed (be selecting the WLAN's checkbox). Use the **Select All** button to associate each WLAN with the selected list item.
5. To remove the WLAN Mappings, select the **Deselect All** button to clear the mappings.
6. Refer to the **Status** field for a display of the current state of the requests made from the applet. Requests are any "SET/GET" operation from the applet. The Status field displays error messages if something goes wrong in the transaction between the applet and the switch.
7. Click **OK** to save and add the new configuration and close the dialog window.
8. Click **Cancel** to close the dialog without committing updates to the running configuration.

4.5.6 NAC Configuration Examples Using the Switch CLI

The following are NAC include list, exclude list and WLAN configuration examples using the switch CLI interface:

4.5.6.1 Creating an Include List

Since few devices require NAC, Motorola recommends using the "bypass-nac-except-include-list" option. Refer to the commands below to create a NAC Include List:

1. Create a NAC include list.

```
RFS7000(config-wireless)#client include-list Desktop
RFS7000(config-wireless-client-list)#
```

NOTE The instance changes from `(config-wireless)` to `(config-wireless-client-list)`.

2. Add a host entry to the include list. This adds a specified MAC entry/MAC range into the client's include list.

```
RFS7000(config-wireless-client-list)#station pc1 AA:BB:CC:DD:EE:FF
RFS7000(config-wireless-client-list)#
```

3. Associate the include list to a WLAN. This adds the client's include list into the WLAN.

```
RFS7000(config-wireless-client-list)#wlan 1
RFS7000(config-wireless-client-list)#
```

4.5.6.2 Creating an Exclude List

To create a NAC Exclude List:

1. Define the NAC include list.

```
RFS7000(config-wireless)#client exclude-list Desktop
RFS7000(config-wireless-client-list)#
```

2. Add a host entry into the exclude list.

```
RFS7000(config-wireless-client-list)#station pc10 AB:BC:CD:DE:EF:FA
RFS7000(config-wireless-client-list)#
```

3. Associate the exclude list to a WLAN.

```
RFS7000(config-wireless-client-list)#wlan 1
RFS7000(config-wireless-client-list)#
```

4.5.6.3 Configuring the WLAN for NAC

Many handheld devices are required to bypass NAC and a few laptops and desktops are required to be NAC validated.

1. Set the NAC mode for WLAN. A NAC validation is conducted for station entries in the include list. The station entries are authenticated using the Radius server.

```
RFS7000(config-wireless)#wlan 1 nac-mode bypass-nac-except-include-list
RFS7000(config-wireless)#
```

2. Configure the WLAN's NAC server settings.
   a. Configure the NAC Server's IP address.

```
RFS7000(config-wireless)#wlan 1 nac-server primary 192.168.1.10
RFS7000(config-wireless)#
```

   b. Configure the NAC Server's Radius Key.

```
RFS7000(config-wireless)#wlan 1 nac-server primary radius-key my-secret
RFS7000(config-wireless)#
```

NOTE Configure the secondary NAC server for redundancy.

   c. Configure the secondary NAC server's IP address.

```
RFS7000(config-wireless)#wlan 1 nac-server secondary 192.168.1.20
RFS7000(config-wireless)#
```

   d. Configure the secondary NAC Server's Radius Key.

```
RFS7000(config-wireless)#wlan 1 nac-server secondary radius-key my
secret-2
RFS7000(config-wireless)#
```

3. MUs not NAC authenticated use Radius for authentication. To configure the WLAN's Radius settings:
   a. Configure the Radius server's IP address.

      ```
      RFS7000(config-wireless)#wlan 1 radius-server primary 192.168.1.30
      RFS7000(config-wireless)#
      ```

   b. Configure the server's Radius Key

      ```
      RFS7000(config-wireless)#wlan 1 radius-server primary radius-key my-rad-
      secret
      RFS7000(config-wireless)#
      ```

   c. Configure the secondary Radius server's IP address.

      ```
      RFS7000(config-wireless)#wlan 1 radius-server secondary 192.168.1.40
      RFS7000(config-wireless)#
      ```

   d. Configure the secondary server's Radius Key.

      ```
      RFS7000(config-wireless)#wlan 1 radius-server secondary radius-key my-
      rad-secret-2
      RFS7000(config-wireless)#
      ```

4. Configure the NAC server's timeout and re-transmit settings. The timeout parameter configures the duration for which the switch waits for a response from the Radius server before attempting a retry. This is a global setting for both the primary and secondary server.

   The re-transmit parameter defines the number of retries a switch attempts before dis-associating the MU.

   ```
   RFS7000(config-wireless)#wlan 1 nac-server timeout 30 retransmit 10
   RFS7000(config-wireless)#
   ```

5. Configure WLAN for EAP authentication and define the encryption type.

   ```
   RFS7000(config-wireless)#wlan 1 authentication-type eap
   RFS7000(config-wireless)#wlan 1 encryption-type wep128
   RFS7000(config-wireless)#wlan 1 ssid wlan-1
   ```

4.6 Viewing Associated MUs

The **Mobile Units** screen displays read-only device information for MUs interoperating with the switch managed network. The Mobile Units screen consists tabs supporting the following configuration activities:

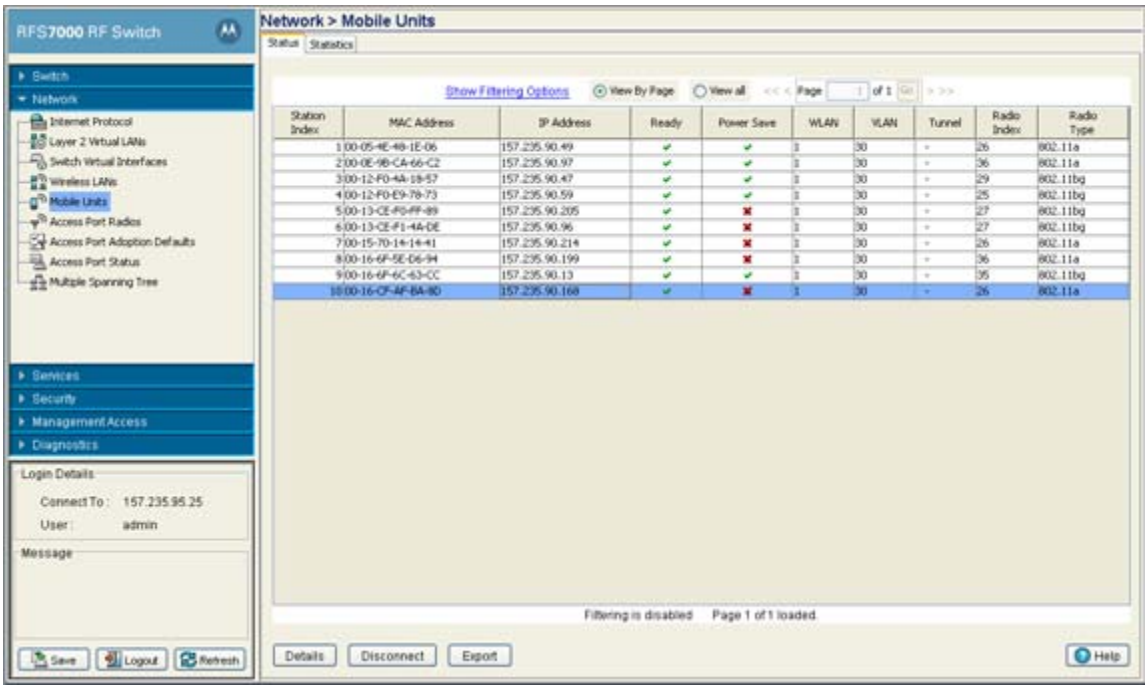
- *Viewing MU Status*
- *Viewing MU Statistics*

NOTE The *Motorola RF Management Software* is a recommended utility to plan the deployment of the switch and view its configuration once operational. Motorola RFMS can help optimize switch positioning and configuration in respect to a WLAN's MU throughput requirements and can help detect rogue devices. For more information, refer to the Motorola Web site.

4.6.1 Viewing MU Status

To view MU Status is detail:

1. Select **Network > Mobile Units** from the main menu tree.
2. Click the **Status** tab.



The Status screen displays the following read-only device information for MUs interoperating within the switch managed network.

Station Index	Displays a numerical device recognition identifier for a specific MU.
MAC Address	Each MU has a unique *Media Access Control* (MAC) address through which it is identified. This address is burned into the ROM of the MU.

IP Address	Displays the unique IP address for the MU. Use this address as necessary throughout the applet for filtering and device intrusion recognition and approval. Only MAC addresses are displayed within the MU IDS filtered list.
Ready	Displays whether the MU is ready for switch interoperation. Values are Yes and No.
Power Save	Displays the current (read-only) *Power-Save-Poll* (PSP) state of the MU. The Power Save field has two potential settings. PSP indicates the MU is operating in Power Save Protocol mode. In PSP, the MU runs enough power to check for beacons and is otherwise inactive. CAM indicates the MU is continuously aware of all radio traffic. CAM is recommended for MUs frequently transmitting with the switch's access ports for periods of two hours or greater.
WLAN	Displays the name of the WLAN the MU's associated AP is connect to.
VLAN	Displays the VLAN the target MU is mapped to.
Tunnel	Displays the tunnel the target MU is mapped to.
Radio Index	The Radio Index is a numerical device recognition identifier for MU radios. The index is helpful to differentiate device radios when a particular MU has more than one radio.
Radio Type	The Radio Type defines the radio used by the adopted MU. The switch supports 802.11b MUs and 802.11 a/b and 802.11 a/g dual-radio MUs. The radio also supports 802.11a only and 802.11g MUs.

3. Click the **Details** button to launch a screen with additional information about the selected MU. For more information, see *Viewing MU Details on page 4-77*
4. Highlight a MU from those listed and click the **Disconnect** button to remove the MU from the list of associated devices.

   Disconnected MUs often become re-connected to the switch. Ensure disconnected MUs are permanently removed from switch association.
5. Click the **Export** button to export the content of the table to a *Comma Separated Values* file (CSV).

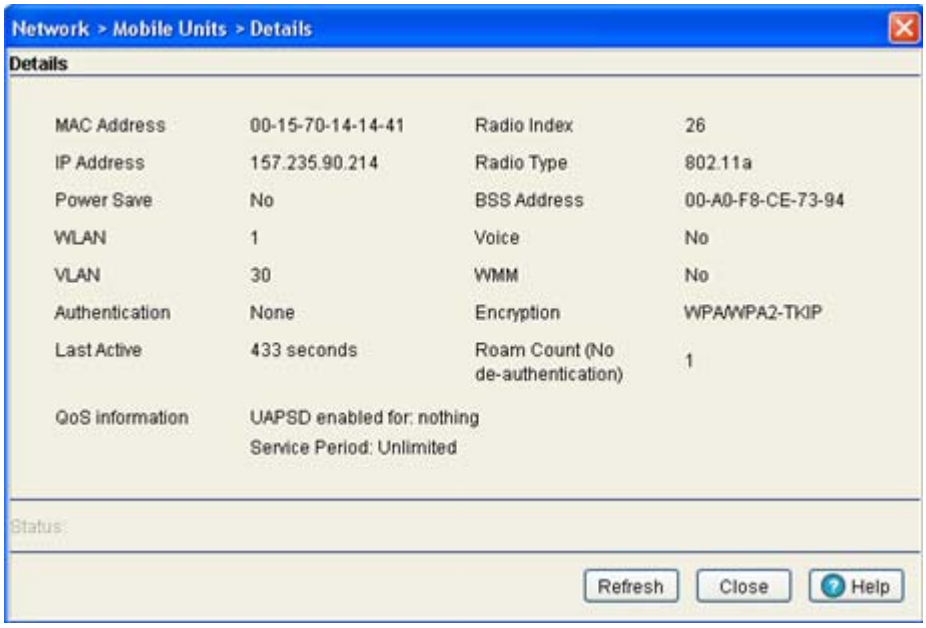
4.6.1.1 Viewing MU Details

The **MUs Details** screen displays read-only MU transmit and receive statistics.

To view MU Details:

1. Select a **Network** > **Mobile Units** from the main menu tree.
2. Click the **Status** tab.

3. Select a MU from the table in the Status screen and click the **Details** button.



4. Refer to the following read-only MU's transmit and receive statistics:.

MAC Address	Displays the hardware or *Media Access Control* (MAC) address for the MU.
IP Address	Displays the unique IP address for the MU. Use this address as necessary throughout the applet for filtering and device intrusion recognition and approval.
Power Save	Displays the current PSP state of the MU. This field has two potential settings. PSP indicates if the MU is operating in PSP mode. In PSP, the MU runs enough power to check for beacons, and is otherwise inactive. CAM indicates the MU is continuously aware of all radio traffic. CAM is recommended for MUs transmitting frequently.
WLAN	Displays of the WLAN the MU is currently associated with.
VLAN	Displays the VLAN parameter for the name of the VLAN the MU is currently mapped to.
Last Active	Displays the time the MU last interoperated with the switch.
QoS Information	Displays an indicator of the wireless device's battery life. Additionally, the service period for the selected MU is also displayed.
Radio Index	Displays is a numerical identifier used to associate a particular Radio with a set of statistics. The Index is helpful for distinguishing the a particular radio from other MU radios with similar configurations.
Radio Type	Displays the radio type used by the adopted MU. The switch supports 802.11b MUs as well as 802.11 a/b and 802.11 a/g dual-radio MUs. The radio also supports 802.11a only and 802.11g MUs.

Base Radio MAC	Displays the SSID of the access port when initially adopted by the switch.
BSS Address	Displays the MU's BSSID.
Voice	Displays whether or not the MU is a voice capable device. Traffic from a voice enabled MU is handled differently than traffic from MUs without this capability. MUs grouped to particular WLANs can be prioritized to transmit and receive voice traffic over data traffic.
WMM	Displays WMM usage status for the MU, including the Access Category currently in use. Use this information to assess whether the MU is using the correct WMM settings in relation to the operation of the switch.
Roam Count	Refer to the Roam Count value to assess the number of times the MU has roamed from the switch.

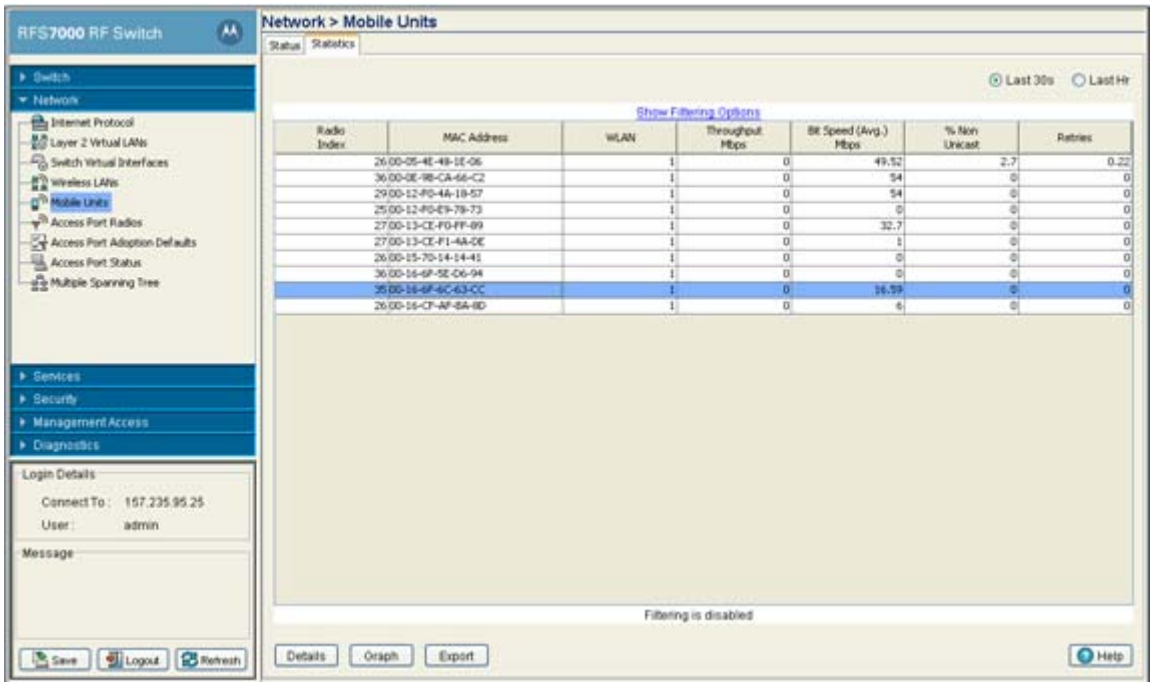
5. Click the **Refresh** button to update the MU Statistics to their latest values.
6. Refer to the **Status** field for the current state of the requests made from applet. This field displays error messages if something goes wrong in the transaction between the applet and the switch.

4.6.2 Viewing MU Statistics

The **Statistics** screen displays read-only statistics for each MU. Use this information to assess if configuration changes are required to improve network performance. If a more detailed set of MU statistics is required, select a MU from the table and click the **Details** button.

To view MU statistics details:

1. Select **Network** > **Mobile Units** from the main menu tree.
2. Click the **Statistics** tab.



3. Select the **Last 30s** checkbox to display MU statistics gathered over the last 30 seconds. This option is helpful for assessing MU performance trends in real-time.
4. Select the **Last HR** checkbox to display MU statistics gathered over the last hour. This option is helpful for assessing performance trends over a measurable period.
5. Refer to following as displayed within the **MU Statistics** tab:

Radio Index	Displays a numerical identifier used to associate a particular radio with a set of statistics. The Index is helpful for distinguishing the radio from other radios with a similar configuration.
MAC Address	Displays the Hardware or *Media Access Control* (MAC) address for the MU. The MAC address is hard coded at the factory and cannot be modified.
WLAN	Displays the name of the WLAN the MU is currently associated with. Use this information to determine if the MU/WLAN placement best suits the intended operation and MU coverage area.
Throughput Mbps	Displays the average throughput in Mbps between the selected MU and the access port. The Rx column displays the average throughput in Mbps for packets received on the selected MU from the access port. The Tx column displays the average throughput for packets sent on the selected MU from the access port.
Bit Speed (Avg.) Mpbs	Displays the average bit speed in Mbps for the selected MU. This includes all packets sent and received.
% Non Unicast	Displays the percentage of the total packets for the selected MU that are non-unicast packets. Non-unicast packets include broadcast and multicast packets.
Retries	Displays the average number of retries per packet. A high number in this field could indicate possible network or hardware problems.

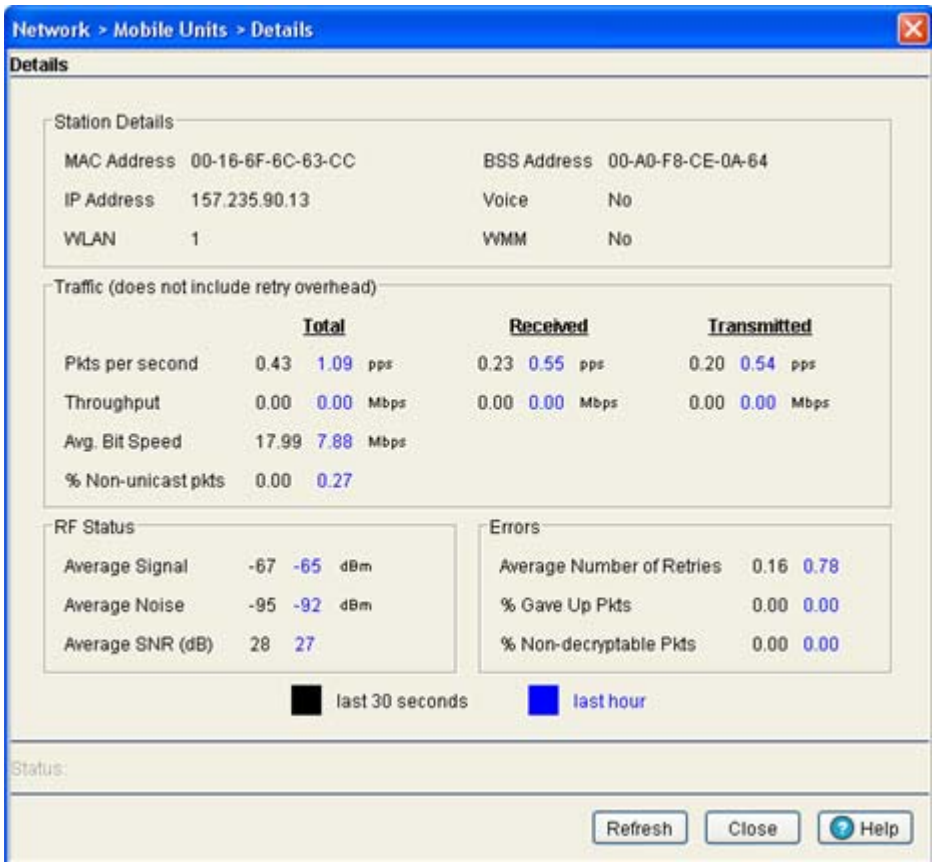
6. Click the **Details** button to launch a screen with additional information about the selected MU. For more information, see *Viewing MU Statistics Details on page 4-80*.
7. Click the **Graph** button to launch a graph with pictorial information about the selected MU in a graphical format. For more information, see *View a MU Statistics Graph on page 4-82*.
8. Click the **Export** button to export the content of the table to a *Comma Separated Values* file (CSV).

4.6.2.1 Viewing MU Statistics Details

The MU Statistics **Details** screen displays additional device address and performance information for the selected MU. Use the WMM information to assess if poor MU performance can be attributed to an inaccurate WMM setting for the type of data transmitted. To view the MU Statistics details:

1. Select a **Network** > **Mobile Units** from the main menu tree.
2. Click the **Statistics** tab.

3. Select a MU from the table displayed in the Statistics screen and click the **Details** button.



The Details screen displays statistics for the selected MU, including:

- *Station Details*
- *Traffic*
- *RF Status*
- *Errors*

Information in black represents the statistics from the last 30 seconds and information in blue represents statistics from the last hour. Use both sets of data to trend stats in real time versus a measurable period (1 hour).

4. Refer to the **Information** field for the following information:

MAC Address	Displays the Hardware or *Media Access Control* (MAC) address for the MU. This address is hard-coded at the factory and cannot be modified.
BSS Address	Displays the MU's BSSID.
IP Address	Displays the current IP address for the MU.
Voice	Displays whether the MU is a voice capable device. Traffic from voice enabled MUs is handled differently (higher priority) than traffic from MUs without this capability.
WLAN	Displays the name of the WLAN the MU is currently associated with.

WMM	Displays WMM usage status for the MU, including the access category currently in use. Use this information to assess whether the MU is using the correct WMM settings in relation to its intended data traffic type.

5. Refer to the **Traffic** field for the following information:

Pkts per second	Displays the average packets per second received by the MU. The Rx column displays the average packets per second received on the selected MU. The Tx column displays the average packets per second sent on the selected MU.
Throughput	Displays the average throughput in Mbps between the MU and the access port. The Rx column displays the average throughput in Mbps for packets received on the selected MU from the access port. The Tx column displays the average throughput for packets sent on the selected MU from the access port.
Avg. Bit Speed	Displays the average bit speed in Mbps on the selected MU. This includes all packets sent and received.
% Non-unicast pkts	Displays the percentage of the total packets for the MU that are non-unicast packets. Non-unicast packets include broadcast and multicast packets.

6. Refer to the **RF Status** field for the following information:

Avg MU Signal	Displays the RF signal strength in dBm for the selected MU.
Avg MU Noise	Displays the RF noise for the selected MU.
Avg MU SNR	Displays the *Signal to Noise Ratio* (SNR) for the selected MU. The Signal to Noise Ratio is an indication of overall RF performance on the wireless network.

7. Refer to the **Errors** field for the following information:

Avg Num of Retries	Displays the average number of retries for the selected MU. Use this information to assess potential performance issues.
% Gave Up Pkts	Displays the percentage of packets the switch gave up on for the selected MU.
% of Undecryptable Pkts	Displays the percentage of undecryptable packets (packets that could not be processed) for the selected MU.

8. Refer to the **Status** field for the current state of the requests made from applet. This field displays error messages if something goes wrong in the transaction between the applet and the switch.
9. Click **Cancel** to close the dialog without committing updates to the running configuration.

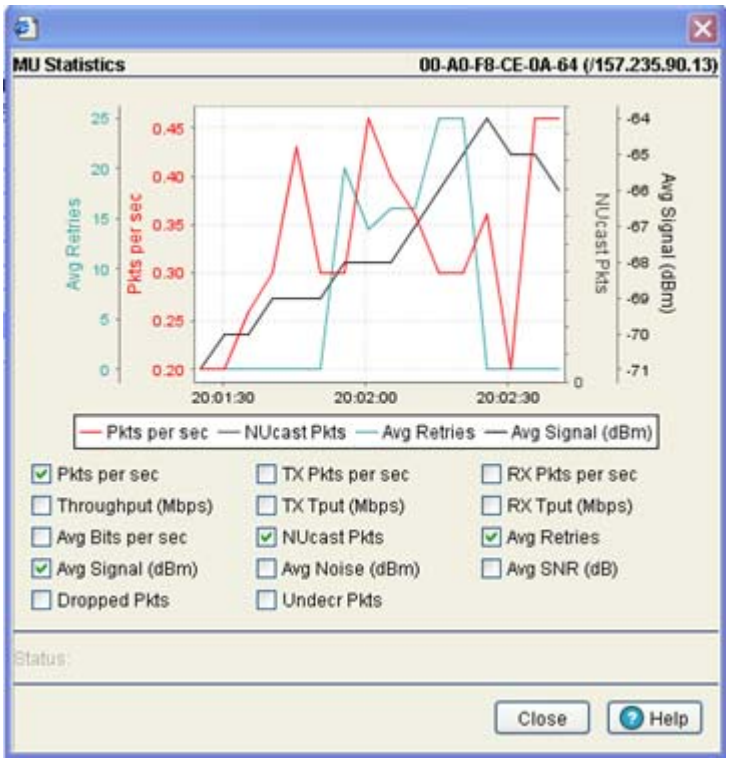
4.6.2.2 View a MU Statistics Graph

The MU Statistics tab has an option for displaying detailed MU statistics for individual MUs in a graphical format. This information can be used for comparison purposes to chart MU and overall switch performance.

To view the MU Statistics in a graphical format:

1. Select a **Network** > **Mobile Units** from the main menu tree.
2. Click the **Statistics** tab.

3. Select a MU from the table displayed in the Statistics screen and click the **Graph** button.



4. Select a checkbox to display that metric charted within the graph. Do not select more than four checkboxes at any one time.
5. Refer to the **Status** field for the current state of the requests made from applet. This field displays error messages if something goes wrong in the transaction between the applet and the switch.
6. Click **Close** to exit the Graph and return to the parent MU Statistics screen.

4.7 Viewing Access Port Radio Information

The **Access Port Radios** screen displays a high-level overview of the APs created for use within the switch managed network. Use this data as necessary to verify the APs that are active, their VLAN assignments, updates to a APs description as well as their current authentication and encryption schemes.

NOTE Each switch can support a maximum of 256 access ports. However, port adoption per switch is determined by the number of licenses acquired.

NOTE The *Motorola RF Management Software* is a recommended utility to plan the deployment of the switch and view its configuration once operational. Motorola RFMS can help optimize the positioning and configuration of a switch and access ports in respect to a WLAN's MU throughput requirements. For more information, refer to the Motorola Web site.

The Access Port Radios screen is partitioned into five tabs supporting the following configuration activities:

- *Configuring Access Port Radios*
- *Viewing AP Statistics*
- *Configuring WLAN Assignment*
- *Configuring WMM*
- *Reviewing Bandwidth Settings*

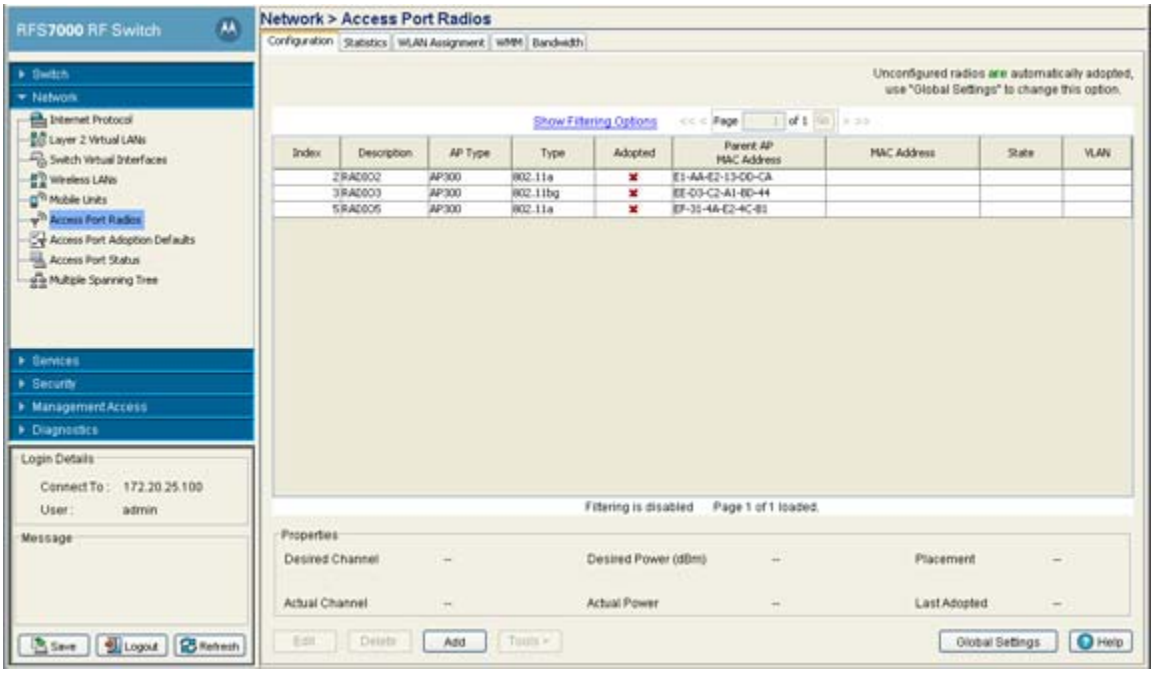
4.7.1 Configuring Access Port Radios

Refer to the **Configuration** tab to view existing radio configurations available to the switch. After reviewing the radios listed, you have the option of editing a radio's properties, deleting a radio, adding a new radio, resetting a radio, scanning available channels or exporting a radio.

To view WLAN configuration details:

1. Select **Network** > **Access Port Radios** from the main menu tree.

2. Click the **Configuration** tab.



3. Refer to the table for the following information:

Index	Displays the numerical index (device identifier) used with the device radio. Use this index (along with the radio name) to differentiate the radio from other device radios.
Description	Displays a user assigned name for the radio.
AP Type	Displays the type of access port detected. The switch supports Motorola AP-300 model access ports.
Type	Use the Type to identify whether the radio is 802.11a radio or an 802.11bg radio.
Adopted	Displays the radio's adoption status. If the radio is adopted, a green check displays. If the radio is not adopted, a red X displays.
Parent AP MAC Address	Displays the access port's Ethernet MAC (the device MAC address that is printed on the casing of the unit). Please do not confuse this BSSID MAC with the access port's Ethernet MAC address.
MAC Address	The Base Radio MAC is the radio's first MAC address when it is adopted by the Switch.
State	Display the radio's current operational mode. If the radio is set as a Detector AP, the state is "Detector", otherwise the state is "Normal".
VLAN	Displays the name of the VLAN currently used with each access port radio.

4. Select a radio index and refer to the **Properties** field for the following

Desired Channel	When the radio's channel is configured statically, the Actual Channel and Desired Channel are the same. If using ACS (*Automatic Channel Selection*), the switch selects a channel for the radio. The Desired Channel displays "ACS" and the Actual channel displays the channel selected for the radio. When set to Random, the applet determines the channel's designation.
Actual Channel	When the radio's channel is configured statically, the Actual Channel and Desired Channel are the same. If using ACS, the switch selects a channel for the radio. The Desired channel displays "ACS" and the Actual Channel displays the channel selected for the radio.
Desired Power (dBm)	Displays the configured power setting in dBm for the selected radio. In most cases, the Desired Power and Actual Power are the same unless the desired power level would put the radio's output power outside the accepted regulatory compliance range.
Actual Power	Displays the current power level in dBm for the selected radio. In most cases, the Desired Power and Actual Power are the same unless the desired power level would put the radio's output power outside the accepted regulatory compliance range.
Placement	When the radio is adopted using the default configuration, the power for the radio can be defined as "Indoor" or "Outdoor." However, some countries have restrictions for the use of outdoor radios. If using a value of "Outdoor" verify it is in compliance with the country of operation's regulatory restrictions.
Last Adopted	Displays the time this radio was last adopted by the switch.

5. Click the **Edit** button to launch a screen used to configure radio specific parameters. For more information, see *Editing AP Settings on page 4-88*.
6. Click the **Delete** button to remove a radio. However, before a radio can be removed, the radio's BSS mapping must be removed.
7. Click the **Add** button to add a radio. The radio must be added before the radio can be adopted. For more information, see *Adding APs on page 4-93*.
8. Click the **Tools >** button to displays a submneu with **Reset**, **Run ACS** and **Export** options.

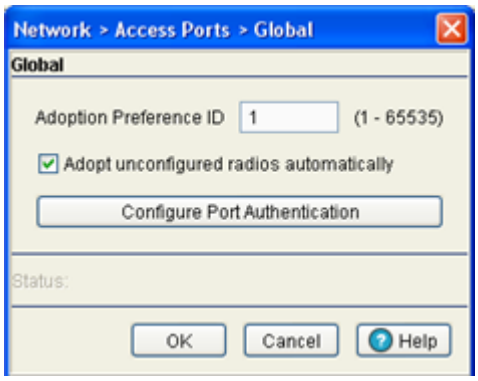
   Select the Reset option to reset the selected access port's radio. Select the **Run ACS Now** option to scan all channels and discover which radios are adopted and on what channel. ACS then analyzes the radios' channels and moves the radio to the channel where it is least likely to have interference from other radios. Use the **Export** option to move the contents of the table to a *Comma Separated Values* file (CSV).
9. Click the **Global Settings** button to display a screen with settings applying to all radios on the system. For more information, see *Configuring an AP's Global Settings on page 4-86*.

4.7.1.1 Configuring an AP's Global Settings

Use the **Global Settings** screen to define an adoption preference ID for the switch and enable an option to adopt non-configured radios. This can be helpful when you do not want to change an access port's configuration but require the access port be adopted.

To edit Global Radio configuration settings:

1. Select **Network** > **Access Port Radios** from the main menu tree.
2. Click the **Configuration** tab.
3. Click the **Global Settings** button to display a screen containing global settings which apply to all radios on the switch.



4. Set an **Adoption Preference ID** value between 1 and 65535.

   To define a radio as preferred, the access port preference ID should be same as the adoption preference ID. The adoption preference ID is used for AP load-balancing. A switch will preferentially adopt access ports having the same adoption-preference-id as the switch itself.

   The Adoption Preference ID defines the switch preference ID. The value can be between 1 and 65535. To define radios as preferred, the access port preference ID should be same as the adoption preference ID. If the value is set to 0, the switch automatically changes the value to 1.

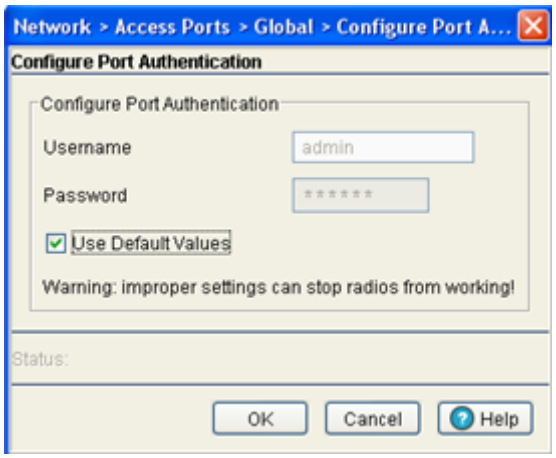
   The adoption preference ID is used for AP load-balancing. A switch preferentially adopts APs which have the same adoption-preference-id as the switch itself.
5. To enable the automatic adoption of non-configured radios on the network, select the **Adopt unconfigured radios automatically** option. Default radio settings are applied to access ports when automatically adopted. Enable this option to allow adoption even when the access port is not configured. Default radio settings are applied to access ports adopted automatically.
6. Click the **Configure Port Authentication** button to open a new dialogue with port authentication configuration information.
7. Click **OK** to save the changes and return to the previous screen.

Port Authentication

To configure the port authentication settings on an access port:

1. Select **Network** > **Access Port Radios** from the main menu tree.
2. Click the **Configuration** tab.
3. Click the **Global Settings** button.
4. Click the **Configure Port Authentication** button.

5. Enter the 802.1x **Username** assigned to the access port.



6. Enter the 802.1x **Password** (for the corresponding username) providing authorization for access port authorization adoption.
7. Check the **Use Default Values** option checkbox to set the Username and Password to factory default values. The access port can get disconnected if the 802.1x authenticator is not configured accordingly.

NOTE 802.1x username and password information is only passed to adopted access ports when the Username and Password are set. Any AP adopted after this does not automatically receive a username and password.

NOTE After setting the username and password to factory default settings, the system must be rebooted before the factory default settings are applied.

8. Refer to the **Status** field for the current state of the requests made from applet. This field displays error messages if something goes wrong in the transaction between the applet and the switch.
9. Click **OK** to set the username and password for the adopted access port.
10. Click **Cancel** to close the dialog without committing updates to the running configuration.

4.7.1.2 Editing AP Settings

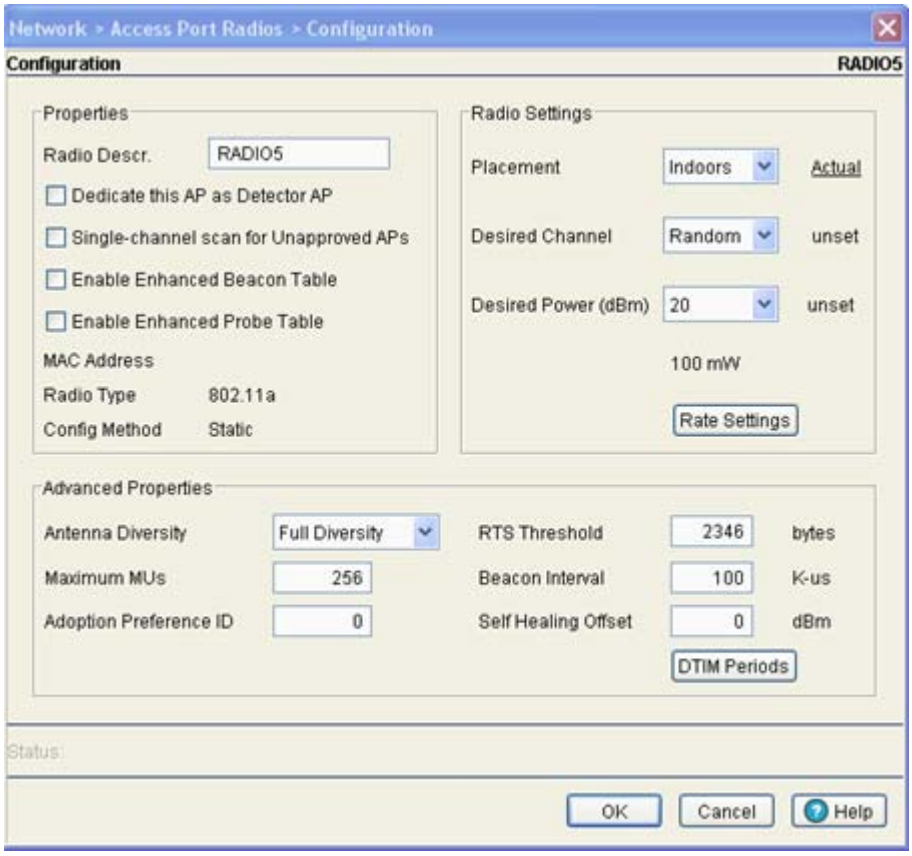
The **Edit** screen provides a means of modifying the properties of an existing radio. This is often necessary when the radio's intended function has changed and its name needs modification or if the radio now needs to be defined as a detector radio. The Edit screen also enables you to modify placement, channel and power settings as well as a set of advanced properties in case its transmit and receive capabilities need to be adjusted.

NOTE The screen display can vary slightly depending on whether the access port radio is an 802.11a or 802.11bg model.

To edit a radio's configuration:

1. Select **Network** > **Access Port Radios** from the main menu tree.
2. Click the **Configuration** tab.

3. Select a radio to edit from the table.
4. Click the **Edit** button to display a screen containing settings for the selected radio.



5. In the **Radio Descr.** field, enter a brief description to differentiate the radio. The description is used to describe radios of the same type and can be used to locate a radio if there are any problems.
6. Select the **Dedicate this AP as Detector AP** to use this radio as a detector port to identify rogue APs on the network

   Setting this radio as a detector dedicates the radio to detect rogue APs on the network. Dedicated detectors do not service clients.
7. Select the **Single-channel scan for Unapproved APs** checkbox to enable the switch to scan for rogue devices using the radio's current channel of operation.
8. Select the **Enable Enhanced Beacon Table** checkbox to allow adopted access port or access point radios to scan for potentially unauthorized APs across all bands.

   This option utilizes radio bandwidth, but is an exhaustive means of scanning across all available channels and listening for AP beacon traffic. Once probe responses are received, a network device management application like Motorola RFMS or the *Wireless Intrusion Protection System* (WIPS) can locate the device and remove it if defined as unauthorized.
9. Select the **Enable Enhanced Probe Table** checkbox to enable an adopted access port or access point radio to forward the probes required to obtain MU RSSI information.

   RSSI data (as obtained by at least three detecting radios) can be used by the Motorola RFMS application to triangulate the location of a MU on a site map representative of the actual physical dimensions of the switch radio coverage area. Once located on a site map, intuitive decisions can be made regarding the MU's authorization within the switch managed network.

10. From within the Radio Settings field, define the **Placement** of the access port as either **Indoors** or **Outdoors**.

    An access port can be set for Indoors or Outdoors use depending on the model and the placement location. Power settings and channel selection options differ based on each country's regulatory rules and whether or not the unit is placed indoors or outdoors.

11. Select a channel for communications between the access port and its associated MUs within the **Desired Channel** field.

    The selection of a channel determines the available power levels. The range of legally approved communication channels varies depending on the installation location and country. The selected channel can be a specific channel, "Random," or "ACS." Random assigns each radio a random channel. ACS (*Automatic Channel Selection*) allows the switch to systematically assign channels. Default is Random.

12. After first selecting a channel, select a power level in dBm for RF signal strength in the **Desired Power (dBm)** field.

    The optimal power level for the specified channel is best determined by a site survey prior to installation. Available settings are determined according to the selected channel. Set a higher power level to ensure RF coverage in WLAN environments that have more electromagnetic interference or greater distances between the access port and MUs. Decrease the power level according to the proximity of other access ports. Overlapping RF coverage may cause lost packets and problems for roaming devices trying to connect to an access port. After setting a power level, channel and placement the RF output power for the access port is displayed in mW. The default is 20 dBm (802.11bg), 17 dBm (802.11a).

NOTE After setting a power level, channel and placement, the RF output power for the access port displays in mW.

13. To configure optional rate settings, click the **Rate Settings** button to display a new dialogue containing rate setting information. Instructions on configuring rate settings is described in *Configuring Rate Settings on page 4-92*.

14. In most cases, the default settings defined for the **Advanced Properties** are sufficient. If needed, they can be modified for the following:

    Antenna Diversity — Use the drop-down menu to configure the Antenna Diversity settings for access ports using external antennas. Options include:

    - *Full Diversity*: Utilizes both antennas to provide antenna diversity.
    - *Primary Only*: Enables only the primary antenna.
    - *Secondary Only*: Enables only the secondary antenna.

    Antenna Diversity should only be enabled if the access port has two matching external antennas. The default value is **Full Diversity**

    Maximum MUs — Sets the number of MUs that can associate to a radio. The maximum number of MUs is 256.

Adoption Preference ID	Displays the preference ID of the switch.The value can be set between 1 and 65535. To define the radios as preferred, the access port preference ID should be same as adoption preference ID. The adoption preference ID is used for AP load-balancing. A switch will preferentially adopt APs which have the same adoption-preference-ID as the switch itself.
Short Preambles only	If using an 802.11bg radio, select this checkbox for the radio to transmit using a short preamble. Short preambles improve throughput. However, some devices (SpectraLink phones) require long preambles. This checkbox does not display if using an 802.11a radio.
RTS Threshold	Specify a *Request To Send* (RTS) threshold (in bytes) for use by the WLAN's adopted access ports. RTS is a transmitting station's signal that requests a *Clear To Send* (CTS) response from a receiving station. This RTS/CTS procedure clears the air where many MUs are contending for transmission time. Benefits include fewer data collisions and better communication with nodes that are hard to find (or hidden) because of other active nodes in the transmission path. Control RTS/CTS by setting an RTS threshold. This setting initiates an RTS/CTS exchange for data frames larger than the threshold, and sends (without RTS/CTS) any data frames smaller than the threshold. Consider the trade-offs when setting an appropriate RTS threshold for the WLAN's access ports. A lower RTS threshold causes more frequent RTS/CTS exchanges. This consumes more bandwidth because of additional latency (RTS/CTS exchanges) before transmissions can commence. A disadvantage is the reduction in data-frame throughput. An advantage is quicker system recovery from electromagnetic interference and data collisions. Environments with more wireless traffic and contention for transmission make the best use of a lower RTS threshold. A higher RTS threshold minimizes RTS/CTS exchanges, consuming less bandwidth for data transmissions. A disadvantage is less help to nodes that encounter interference and collisions. An advantage is faster data-frame throughput. Environments with less wireless traffic and contention for transmission make the best use of a higher RTS threshold. Default is 2346.
Beacon Interval	Specify a beacon interval in units of 1,000 microseconds (K-us). This is a multiple of the DTIM value, for example, 100: 10. (See "DTIM Period," below). A beacon is a packet broadcast by the adopted access ports to keep the network synchronized. Included in a beacon is information such as the WLAN service area, the radio-port address, the broadcast destination addresses, a time stamp, and indicators about traffic and delivery such as a DTIM. Increase the DTIM/beacon settings (lengthening the time) to let nodes sleep longer and preserve battery life. Decrease these settings (shortening the time) to support streaming-multicast audio and video applications that are jitter-sensitive. The default is 100 K-us.

Self Healing Offset	When an access port increases its power to compensate for a failure, power is increased to the country's regulatory maximum. Set the Self Healing Offset to reduce the country's regulatory maximum power if access ports are situated close to each other or if an access port uses an external antenna.
DTIM Periods	Select the DTIM periods button to specify a period for *Delivery Traffic Indication Messages* (DTIM) for BSS IDs 1-4. This is a divisor of the beacon interval (in milliseconds), for example, 10 : 100. (See "Beacon Interval," above). A DTIM is periodically included in the beacon frame transmitted from adopted access ports. The DTIM period determines how often the beacon contains a DTIM, for example, 1 DTIM for every 10 beacons. The DTIM indicates broadcast and multicast frames (buffered at the access port) are soon to arrive. These are simple data frames that require no acknowledgement, so nodes sometimes miss them. Increase the DTIM/beacon settings (lengthening the time) to let nodes sleep longer and preserve their battery life. Decrease these settings (shortening the time) to support streaming-multicast audio and video applications that are jitter-sensitive. The default DTIM period is 10 beacons for BSS 1-4.

15. Refer to the **Status** field for the current state of the requests made from applet. This field displays error messages if something goes wrong in the transaction between the applet and the switch.
16. Click **OK** to use the changes to the running configuration and close the dialog.
17. Click **Cancel** to close the dialog without committing updates to the running configuration.

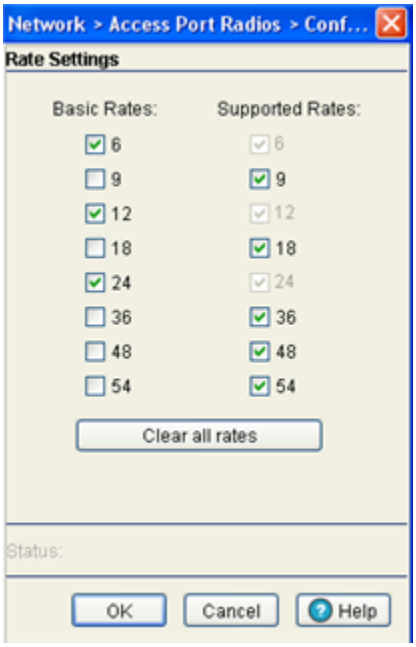
Configuring Rate Settings

Use the **Rate Settings** screen to define a set of basic and supported rates for the target radio. This allows the radio to sync with networks using varying data rates and allows the radio to default to a predefined set of data rates when higher data rates cannot be maintained.

To configure Rate Settings for a radio:

1. Click the **Rate Settings** button within the radio edit screen to launch a new screen with rate setting information.
2. Check the boxes next to all the **Basic Rates** you want supported.

   Basic Rates are used for management frames, broadcast traffic and multicast frames. If a rate is selected as a basic rate it is automatically selected as a supported rate.
3. Check the boxes next to all the **Supported Rates** you want supported.



Supported rates allow an 802.11 network to specify the data rate it supports. When a MU attempts to join the network, it checks the data rate used on the network. If a rate is selected as a basic rate, it is automatically selected as a supported rate. The basic default rates for an 802.11a radio differ from those 802.11b default rates, as an 802.11a radio can support a maximum data rate of 54Mbps, while an 802.11b radio can support a maximum data rate of 11Mbps.

4. Click the **Clear all rates** button to uncheck all of the Basic and Supported rates.
5. Refer to the **Status** field for the current state of the requests made from applet. This field displays error messages if something goes wrong in the transaction between the applet and the switch.
6. Click **OK** to use the changes to the running configuration and close the dialog.
7. Click **Cancel** to close the dialog without committing updates to the running configuration.

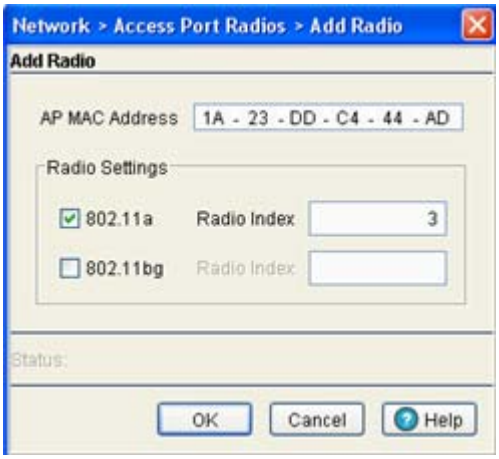
4.7.1.3 Adding APs

The **Add Radio** screen provides a facility for creating a new (unique) radio index for inclusion within the Configuration screen. Use the Add screen to add the new radio's MAC address and define its radio type.

To add a Radio to the switch:

1. Select **Network** > **Access Port Radios** from the main menu.
2. Click the **Configuration** tab.

3. Click the **Add** button to display a screen containing settings for adding a new radio



4. Enter the device **MAC Address** (the physical MAC address of the radio). Ensure this address is the actual hard-coded MAC address of the device.
5. Select the radio type checkboxes corresponding to the type of AP radio used.
6. Enter a numerical value in the **Radio Index** field for each selected radio.

   The Radio Index is a numerical value assigned to the radio as a unique identifier. For example; 1, 2, or 3. The index is helpful for differentiating radios of similar type and configuration.
7. Refer to the **Status** field for the current state of the requests made from applet. This field displays error messages if something goes wrong in the transaction between the applet and the switch.
8. Click **OK** to use the changes to the running configuration and close the dialog.
9. Click **Cancel** to close the dialog without committing updates to the running configuration.

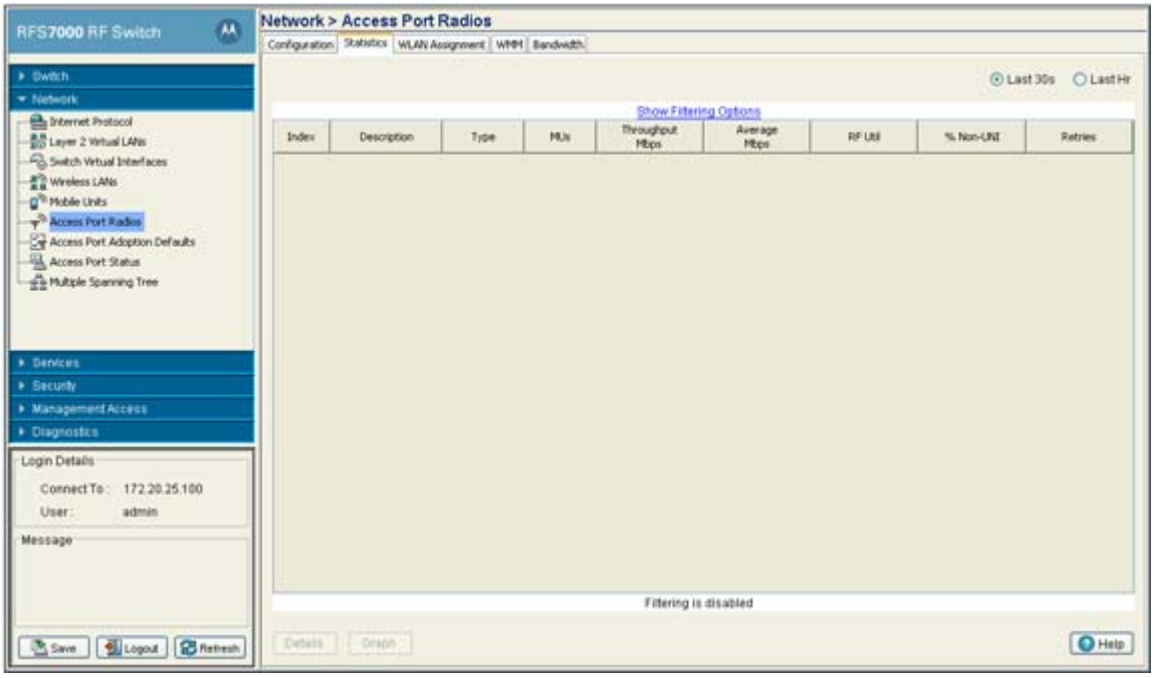
4.7.2 Viewing AP Statistics

Refer to the **Statistics** tab for information and high-level performance data for individual radios. Performance information can be reviewed for either a 30 second or one hour interval. Use the Details button to display additional information for an individual radio.

To view Radio Statistics:

1. Select **Network** > **Access Port Radios** from the main menu tree.

2. Click the **Statistics** tab.



3. To define the time frame for the radio statistics, select either **Last 30s** or **Last Hr** above the statistics table.
   - Select the Last 30s radio button to display statistics for the last 30 seconds.
   - Select the Last Hr radio button to display statistics from the last hour.
4. Refer to the table for the following information:

Index	Displays the numerical index (device identifier) used with the radio. Use this index (along with the radio name) to differentiate the radio from other device radios.
Description	Displays the name used with the radio. Use this name (along with the radio index) to differentiate the radio from other device radios.
Type	Identifies whether the radio is an 802.11a radio or an 802.11 bg radio.
MUs	Displays the number of MUs currently associated with the access port.
Throughput Mbps	Displays the average throughput in Mbps for the selected radio. The Rx column displays the average throughput in Mbps for packets received on the selected radio. The Tx column displays the average throughput for packets sent on the selected radio.
Average Mbps	Displays the average bit speed in Mbps on the selected access port. This value includes packets both sent and received.
RF Util	Displays the percentage of the total packets for the selected radio that are non-unicast packets. Non-unicast packets include broadcast and multicast packets.
% Non-UNI	Displays the percentage of packets for the selected radio that are non-unicast packets. Non-unicast packets include broadcast and multicast packets.

Retries	Displays the average number of retries for all MUs associated with the selected radio.

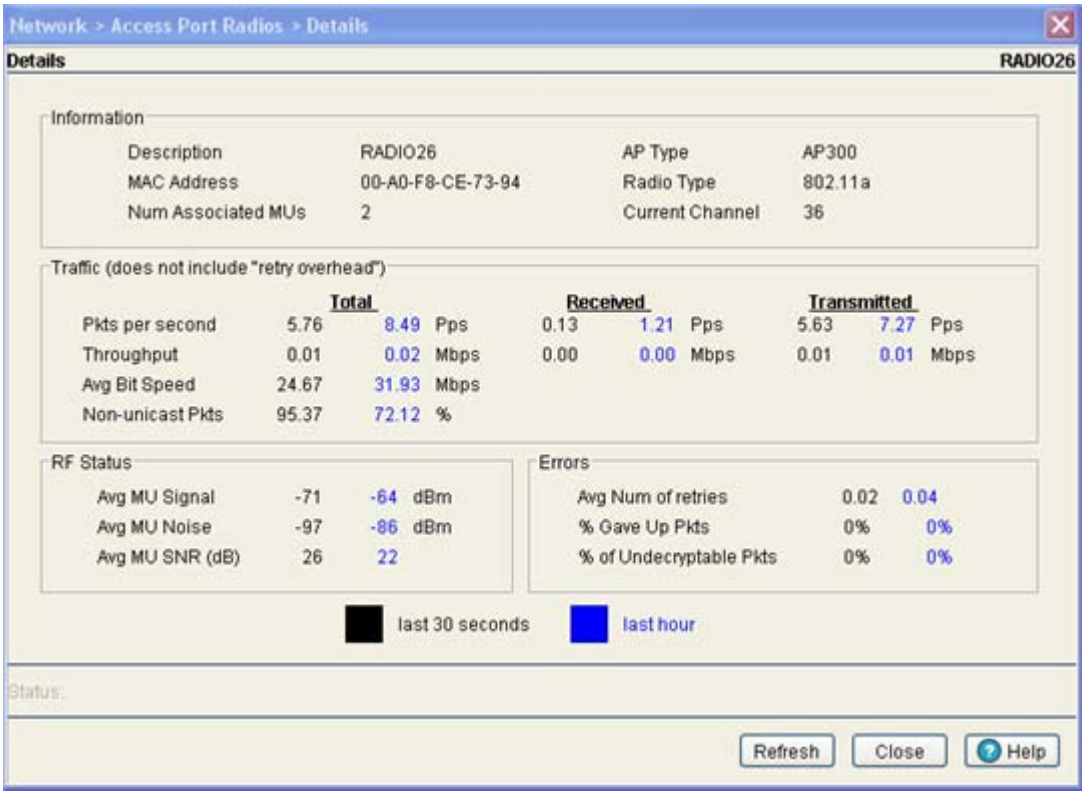
5. Select a radio from those displayed and click the **Details** button for additional radio information. For more information, see *Viewing APs Details on page 4-96*.
6. Select a radio and click the **Graph** button to display radio performance data in statistical format. For more information, see *Viewing an AP's Graph on page 4-98*.

4.7.2.1 Viewing APs Details

The **Details** screen provides additional (and more specific) traffic, performance and error information for the selected radio.

To view Radio Statistics Details:

1. Select **Network** > **Access Port Radios** from the main menu tree.
2. Click the **Statistics** tab.
3. Select a radio from the table and click the **Details** button to display a screen with detailed statistics for that radio.



Radio statistics details are split into four sections: **Information**, **Traffic**, **RF Status** and **Errors**. Information in black represents the statistics from the last 30 seconds and information in blue represents statistics from the last hour.

4. Refer to the **Information** field for the following information:

Description	Displays a brief description of the radio to help differentiate it from similar models.

MAC Address	Displays the Hardware or *Media Access Control* (MAC) address for the access port. Access ports with dual radios have a unique hardware address for each radio.
Num Associated MUs	Displays the number of MUs currently associated with the radio.
AP Type	Displays the access port model.
Radio Type	Displays whether the access port radio is an 802.11a or 802.11bg radio.
Current Channel	Displays the channel the access port is currently passing traffic on. If the channel is displayed in red, it means the configured channel does not match the current channel. The configured channel in this case, is the value in parentheses. The AP may not be operating on the configured channel for 2 reasons: Uniform spreading is enabled or radar was encountered on the configured channel.

5. Refer to the **Traffic** field for the following information:

Pkts per second	Displays the average total packets per second that cross the selected radio. The Rx column displays the average total packets per second received on the selected radio. The Tx column displays the average total packets per second sent on the selected radio. The number in black represents this statistic for the last 30 seconds and the number in blue represents this statistic for the last hour.
Throughput	Displays the average throughput in Mbps on the selected radio. The Rx column displays the average throughput in Mbps for packets received on the selected radio. The Tx column displays the average throughput for packets sent on the selected radio. The number in black represents this statistic for the last 30 seconds and the number in blue represents this statistic for the last hour.
Avg Bit Speed	Displays the average bit speed in Mbps on the selected radio. This includes all packets that are sent and received. The number in black represents this statistic for the last 30 seconds and the number in blue represents this statistic for the last hour.
Non-unicast Pkts	Displays the percentage of the total packets for the selected radio that are non-unicast packets. Non-unicast packets include broadcast and multicast packets. The number in black represents this statistic for the last 30 seconds and the number in blue represents this statistic for the last hour.

6. Refer to the **RF Status** field for the following information:

Avg MU Signal	Displays the average RF signal strength in dBm for all MUs associated with the selected radio. The number in black represents this statistic for the last 30 seconds and the number in blue represents this statistic for the last hour.
Avg MU Noise	Displays the average RF noise for all MUs associated with the selected radio. The number in black represents this statistic for the last 30 seconds and the number in blue represents this statistic for the last hour.

Avg Station SNR	Displays the average *Signal to Noise Ratio* (SNR) for all MUs associated with the selected radio. The Signal to Noise Ratio is an indication of overall RF performance on your wireless network.

7. Refer to the **Errors** field for the following information:

Avg Num of retries	Displays the average number of retries for all MUs associated with the selected radio. The number in black represents this statistic for the last 30 seconds and the number in blue represents this statistic for the last hour.
% Gave Up Pkts	Displays the percentage of packets the switch gave up on for all MUs associated with the selected radio. The number in black represents this statistic for the last 30 seconds and the number in blue represents this statistic for the last hour.
% of Undecryptable Pkts	Displays the percentage of undecryptable packets for all MUs associated with the selected radio. The number in black represents this statistic for the last 30 seconds and the number in blue represents this statistic for the last hour.

8. Refer to the **Status** field for the current state of the requests made from applet. This field displays error messages if something goes wrong in the transaction between the applet and the switch.
9. Click **Refresh** to update the content of the screen with the latest values.
10. Click **Close** to return to the parent Statistics screen.

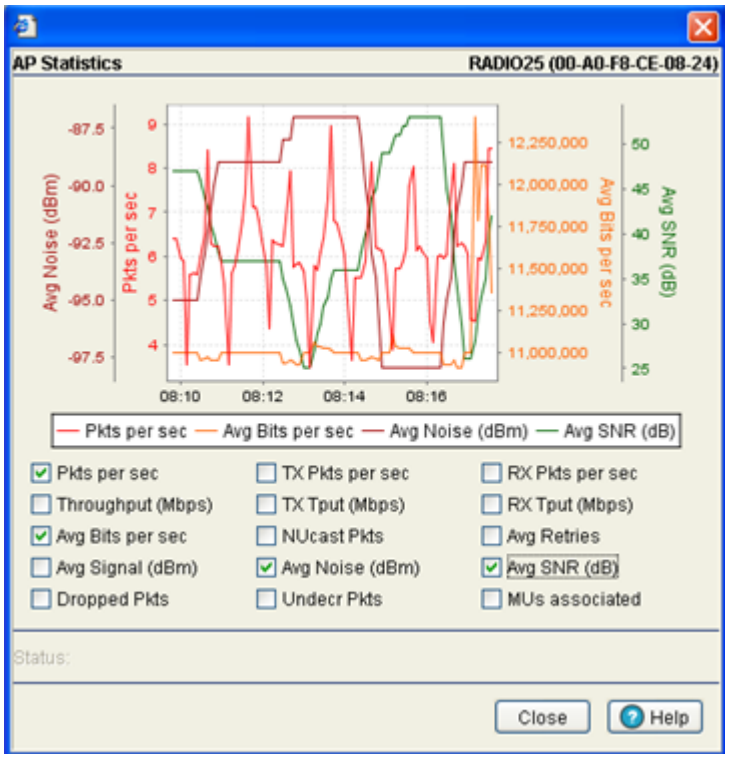
4.7.2.2 Viewing an AP's Graph

The Access Port Radios Statistics tab has an option for displaying detailed access port radio statistics in a graph. This information can be used to chart associated switch radio performance and help diagnose radio performance issues.

To view the MU Statistics in a graphical format:

1. Select a **Network** > **Access Port Radios** from the main menu tree.
2. Click the **Statistics** tab.

3. Select a radio index from the table displayed in the Statistics screen and click the **Graph** button.



4. Select a checkbox to display that metric charted within the graph. Do not select more than four checkboxes at any one time.
5. Refer to the **Status** field for the current state of the requests made from applet. This field displays error messages if something goes wrong in the transaction between the applet and the switch.
6. Click **Close** to exit the Graph and return to the parent Access Port Radios Statistics screen.

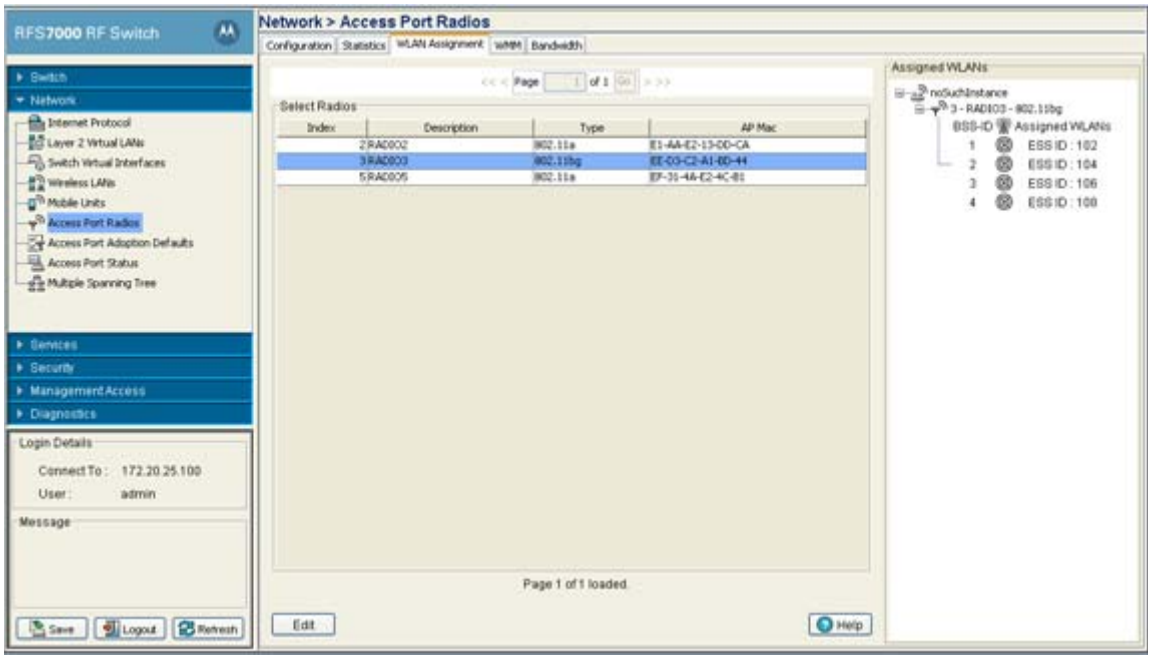
4.7.3 Configuring WLAN Assignment

The **WLAN Assignment** tab displays a high-level description of the radio. It also displays the radios WLAN and BSSID assignments on a panel on the right-hand side of the screen.

To view existing WLAN Assignments:

1. Select **Network** > **Access Port Radios** from the main menu tree.
2. Click the **WLAN Assignment** tab.
3. Use the Filter Options facility (by clicking the Show Filter Options link) to specify if information is filtered by Index (default setting), Description, Type or AP MAC. Select Turn Filtering Off to disable filtering.

4. Select a radio from the table to view WLAN assignment information.



The WLAN Assignment tab is divided into two fields; **Select Radios** and **Assigned WLANs**.

5. Refer to the **Select Radios** field for the following information:

Index	Displays the numerical index (device identifier) used with the radio. Use this index (along with the radio description) to differentiate the radio from other radios with similar configurations.
Description	Displays a description of the Radio. Modify the description as required to name the radio by its intended coverage area or function.
Type	Displays whether the radio is an 802.11a radio or an 802.11 bg radio.
AP Mac	Displays the MAC address of the port in AA-BB-CC-DD-EE-FF format.

The **Assigned WLANs** field displays the WLANs associated to each BSSID used by the radios within the radio table. There can be up to 16 WLANs associated with each BSS. Out of these, one WLAN must be the primary WLAN.

6. Select a WLAN Assignment (by index) and click the **Edit** button to modify its properties. For more information, see *Editing a WLAN Assignment on page 4-100*.
7. To remove an existing WLAN from the list available for WLAN assignment, select the WLAN and click the **Delete** button.

4.7.3.1 Editing a WLAN Assignment

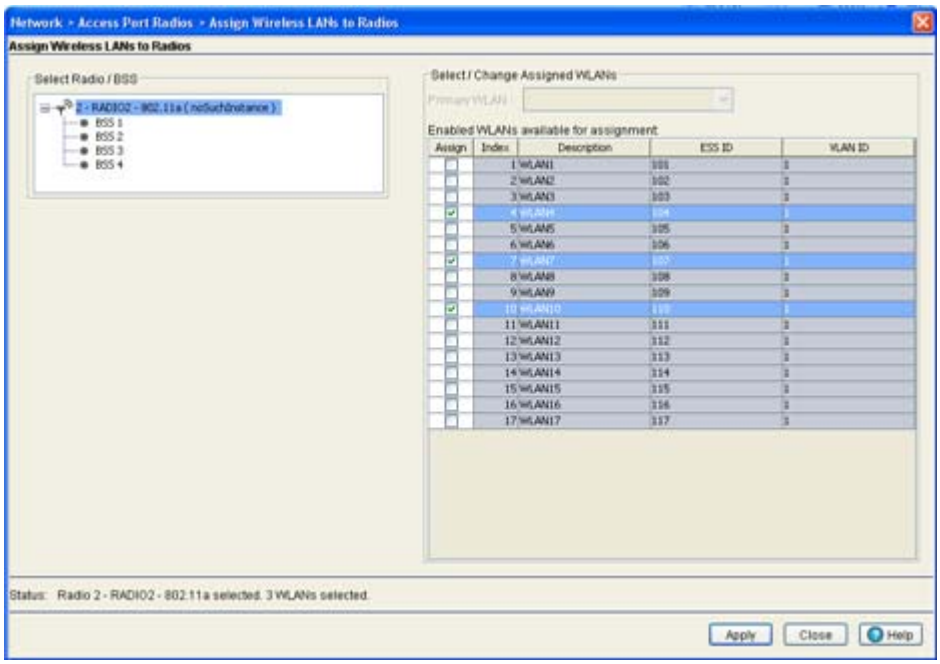
The properties of an existing WLAN assignment can be modified to meet the changing needs of your network,

To edit an exiting WLAN assignment:

1. Select **Network** > **Access Port Radios** from the main menu tree.

2. Click the **WLAN Assignment** tab.
3. Select a radio from the table and click the **Edit** button.

   The **Select Radio/BSS** field displays the WLANs associated to each of the BSSIDs used by the radios within the radio table. Use **Select/Change Assigned WLANs** field to edit the WLAN assignment.



4. Select any of the WLANs from the table to unassign/disable them from the list of available WLANs.
5. Refer to the **Status** field for the current state of the requests made from applet. This field displays error messages if something goes wrong in the transaction between the applet and the switch.
6. Click the **Apply** button to save the modified WLAN assignment.
7. Click **Close** to exit the screen without committing updates to the running configuration.

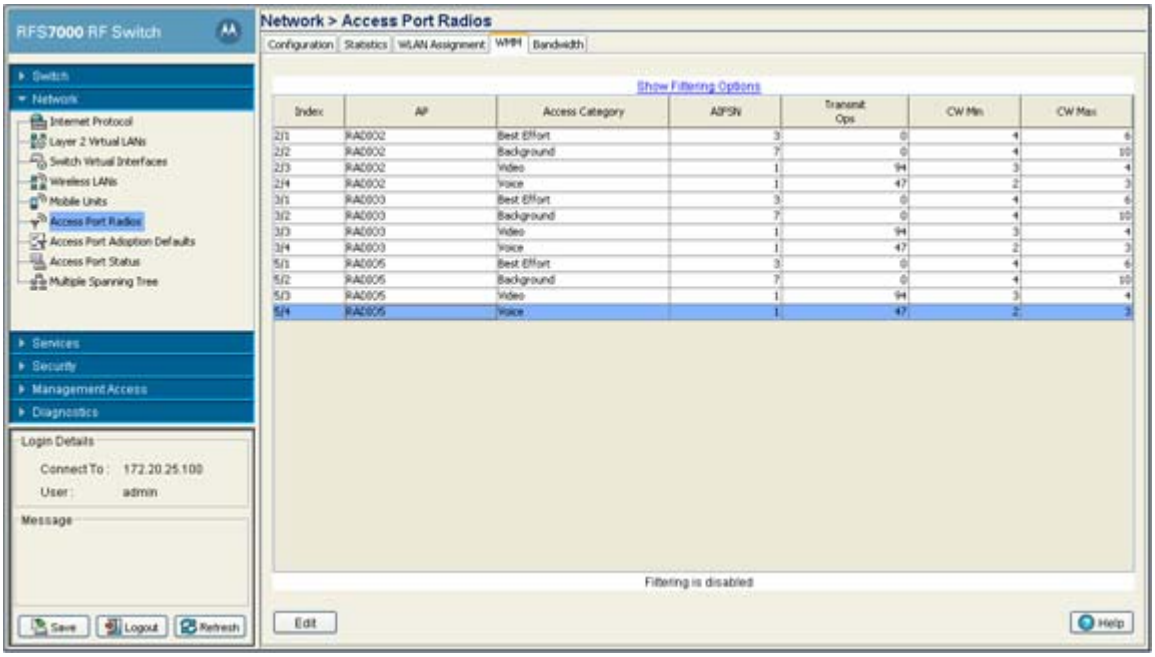
4.7.4 Configuring WMM

Use the **WMM** tab to review each radio's current index (numerical identifier), the Access Category that defines the data type (Video, Voice, Best Effort and Background) as well as the transmit intervals defined for the target access category.

To view existing WMM Settings:

1. Select **Network > Access Port Radios** from the main menu tree.
2. Click the **WMM** tab.

WMM information displays per radio with the following information:



Index	Displays the identifier assigned to each WLAN index, each index is assigned a unique identifier such as (1/4, 1/3, etc.).
AP	Displays the name of the access port associated with the index. The access port name comes from the description field in the Radio Configuration screen.
Access Category	Displays the Access Category currently in use. There are four categories: Video, Voice, Best Effort and Background. Click the Edit button to change the current Access Category. Ensure the Access Category reflects the radio's intended network traffic.
AIFSN	Displays the current *Arbitrary Inter-frame Space Number*. Higher-priority traffic categories should have lower AIFSNs than lower-priority traffic categories. This will causes lower-priority traffic to wait longer before trying to access the medium.
Transmit Ops	Displays the maximum duration a device can transmit after obtaining a transmit opportunity.
CW Min	Displays the CW Max to make the Contention Window. From this range, a random number is selected for the back off mechanism. Lower values are used for higher priority traffic.
CW Max	Displays the CW Min to make the Contention Window. From this range, a random number is selected for the back off mechanism. Lower values are used for higher priority traffic.

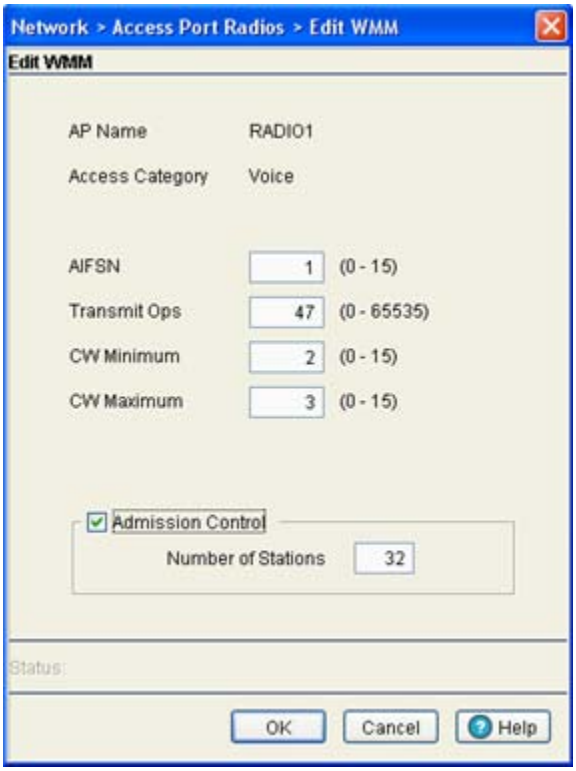
3. Use the Filter Options facility (by clicking the Show Filter Options link) to specify if information is filtered by Index (default setting), AP, Access Category, AIFSN, Transmit Ops, CW Min or CW Max. Select **Turn Filtering Off** to disable filtering.
4. Select a radio and click the **Edit** button to modify its properties. For more information, see *Editing WMM Settings on page 4-103*.

4.7.4.1 Editing WMM Settings

Use the Edit screen to modify a WMM profile's properties (AIFSN, Tx Op, Cw Min and CW Max). Modifying these properties may be necessary as Access Categories are changed and transmit intervals need to be adjusted to compensate for larger data packets and contention windows.

To edit existing WMM Settings:

1. Select **Network > Access Port Radios** from the main menu tree.
2. Click the **WMM** tab.
3. Select a radio from the table and click the **Edit** button to launch a screen displaying the WMM configuration for that radio.



4. Enter a number between 0 and 15 for the **AIFSN** value for the selected radio.

   The AIFSN value is the current *Arbitrary Inter-frame Space Number*. Higher-priority traffic categories should have lower AIFSNs than lower-priority traffic categories. This will causes lower-priority traffic to wait longer before trying to access the medium.

5. Enter a number between 0 and 65535 for the **Transmit Ops** value.

   The Transmit Ops value is the maximum duration a device can transmit after obtaining a transmit opportunity. For higher-priority traffic categories, this value should be set higher.

6. Enter a value between 0 and 15 for the Contention Window minimum value.

   The CW Minimum is combined with the CW Maximum to make the Contention Window. From this range, a random number is selected for the back off mechanism. Lower values are used for higher priority traffic.

7. Enter a value between 0 and 15 for the Contention Window maximum value.

The CW Maximum is combined with the CW Minimum to define the Contention Window. From this range, a random number is selected for the back off mechanism. Lower values are used for higher priority traffic.

8. Select the **Admission Control** checkbox to enable the restriction of MUs using the WMM policy. This may be useful when multimedia traffic would be negatively impacted by an abundance of MU traffic. This setting is not selected by default, but once enabled, has a default value of 32 stations (MUs).
9. Refer to the **Status** field for the current state of the requests made from applet. This field displays error messages if something goes wrong in the transaction between the applet and the switch.
10. Click **OK** to use the changes to the running configuration and close the dialog.
11. Click **Cancel** to close the dialog without committing updates to the running configuration.

4.7.5 Reviewing Bandwidth Settings

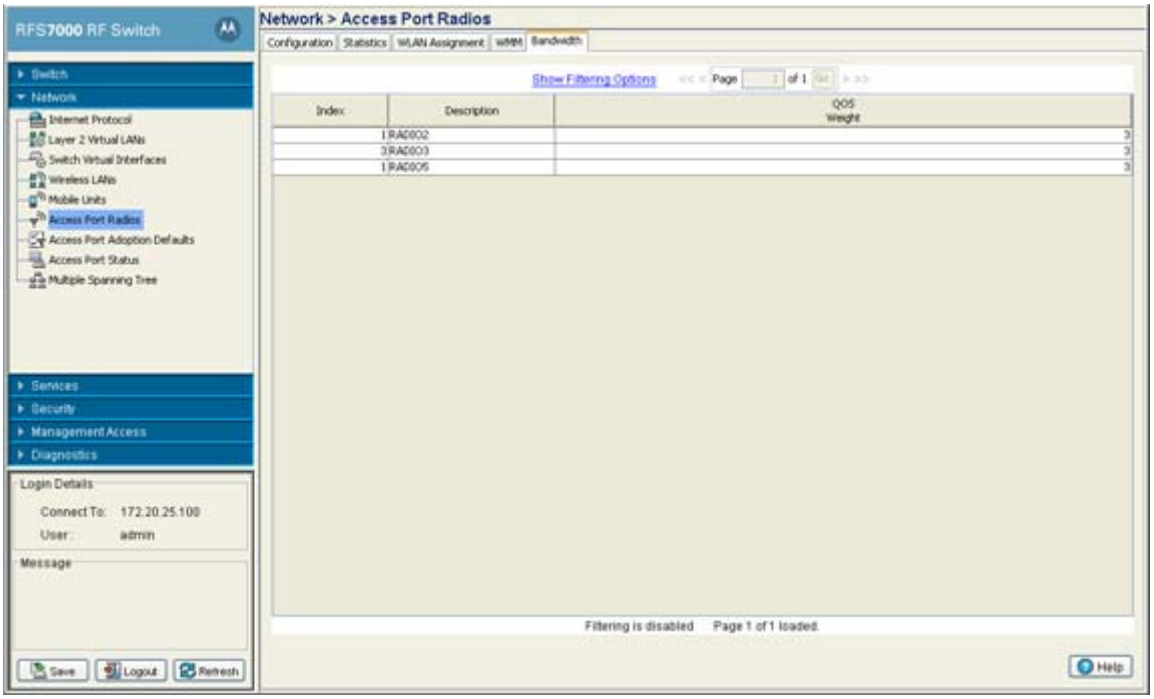
Refer to the **Bandwidth** tab to view the QoS weight associated with each radio when added to a WLAN. The weight represents the switch priority assigned to the traffic transmitted from the radio for the WLAN.

For information on revising the weight assigned to each radio in respect to its intended operation within its assigned WLAN, see *Editing the WLAN Configuration on page 4-27*.

To view existing radio bandwidth weight settings:

1. Select **Network** > **Access Port Radios** from the main menu tree.
2. Click the **Bandwidth** tab.

   Bandwidth information displays per radio with the following data:



Index — Displays the identifier assigned to each radio. This numerical identifier is helpful in differentiating radios with similar configurations.

Description	Displays the description defined for the radio when initially added to the switch managed network. This information can be useful in associating the radio's intended support function with the bandwidth priority assigned.
QoS Weight	The QoS weight displayed represents each radio's transmission priority within the WLAN the radio has been assigned to operate in. A single radio can have different weights within different WLANs based on its intended priority. For information on revising the weight assigned to this radio in respect to its intended operation within its assigned WLAN, see *Editing the WLAN Configuration on page 4-27*.

4.8 Viewing Access Port Adoption Defaults

Use the **Access Port Adoption Defaults** screen to configure radio adoption settings, assign WLANs and security schemes and review each radio type and the Access Category that defines which data type (Video, Voice, Best Effort and Background) the radio has been configured to process. The Access Port Adoption Defaults screen supports the following configuration activities:

- *Configuring AP Adoption Defaults*
- *Configuring Layer 3 Access Port Adoption*
- *Configuring WLAN Assignment*
- *Configuring WMM*

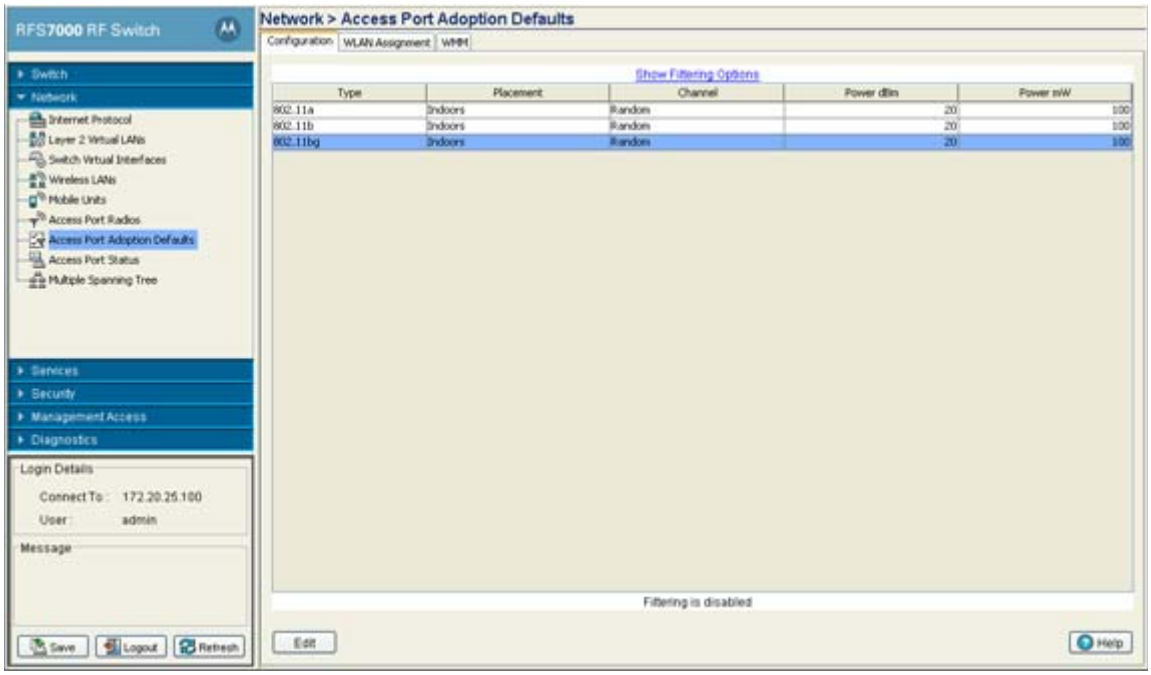
4.8.1 Configuring AP Adoption Defaults

The **Configuration** tab displays current radio adoption settings including radio type, placement, channel setting and power settings. Many of these settings can be modified (as well as radio's current rate settings) by selecting a radio and clicking the Edit button. The displayed settings are the default configurations employed when radios auto-adopt.

To view existing Radio Configuration information:

1. Select **Network** > **Access Port Adoption Defaults** from the main menu tree.

2. Select the **Configuration** tab.



3. Refer to the following information as displayed within the **Configuration** tab:

Type	Displays whether the radio is an 802.11a radio or an 802.11 bg model radio.
Placement	Displays the default placement when an radio auto-adopts and takes on default settings. Options include; Indoor or Outdoor. The default is Indoor.
Channel	Displays the default channel used when the radio auto-adopts and takes on the default settings. This value can be a specific channel, Random, or ACS. Random assigns each radio a random channel. ACS (*Automatic Channel Selection*) allows the switch to systematically assign the channel. The default is random.
Power dBm	Displays the power settings when a radio auto-adopts default settings. Defaults are 20 dBM for 802.11bg and 17 dBm for 802.11a.
Power mW	Displays the default transmit power in mW (derived from the Power dBm setting). Defaults are 100 mW for 802.11bg and 50 mW for 802.11a.

4. To modify a radio's adoption defaults, select a radio and click the **Edit** button. For more information, see *Editing Default Radio Adoption Settings on page 4-107*.

CAUTION An access port is required to have a DHCP provided IP address before attempting layer 3 adoption, otherwise it will not work. Additionally, the access port must be able to find the IP addresses of the switches on the network. To locate switch IP addresses on the network:

- Configure DHCP option 189 to specify each switch IP address.
- Configure a DNS Server to resolve an existing name into the IP of the switch. The access port has to get DNS server information as part of its DHCP information. The default DNS name requested by an AP300 is "Symbol-CAPWAP-Address". However, since the default name is configurable, it can be set as a factory default to whatever value is needed.

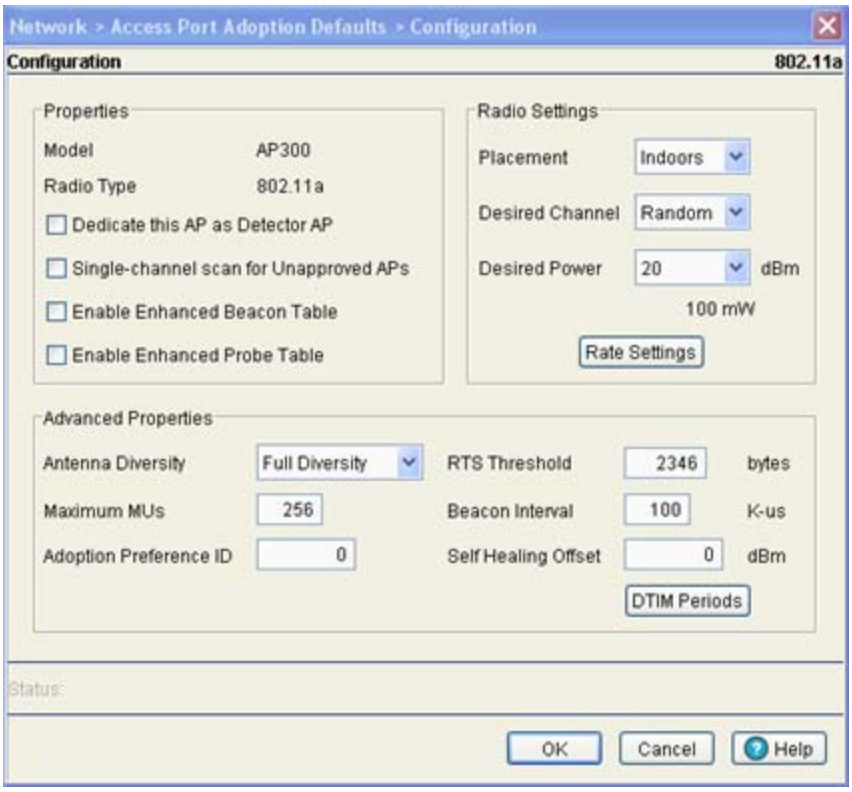
4.8.1.1 Editing Default Radio Adoption Settings

Use the **Edit** screen to dedicate a target radio as a detector radio, as well as change the radio's settings (placement, power and channel) and advanced properties (antenna setting, maximum associations, adoption preference etc.).

To edit radio adoption configuration settings:

1. Select **Network** > **Access Port Adoption Defaults** from the main menu tree.
2. Click the **Configuration** tab.
3. Select a radio from the table.

4. Click the **Edit** button to display a screen to change the radio adoption default values for the selected radio type (either 802.11a or 802.11bg).



The **Properties** field displays the model family for the selected access port. The model is read-only and cannot be modified. The **Radio Type** displays the radio type (802.11a or 802.11bg). This value is also read only and cannot be modified.

5. To use this radio as a detector to identify rogue APs, check the box titled **Dedicate this AP as Detector.** Setting this radio as a detector dedicates this radio to detecting rogue APs on the network. Dedicated detectors do not service clients.
6. Select the **Single-channel scan for Unapproved APs** checkbox to enable the switch to detect rogue devices using the radio's current channel.
7. Select the **Enable Enhanced Beacon Table** checkbox to allow associated access port or access point radios to scan for potentially unauthorized APs across all bands.

   This option utilizes allot of device radio bandwidth, but is an exhaustive means of scanning all available channels and listening for AP beacon traffic. Once probe responses are received, a network device management application like Motorola RFMS or the *Wireless Intrusion Protection System* (WIPS) can be used to locate the device and remove it if defined as unauthorized.
8. Select the **Enable Enhanced Probe Table** checkbox to enable an adopted Access Port or access point radio to forward the probes required to obtain MU RSSI information.

   RSSI data (as obtained by at least three detecting radios) can be used by the Motorola RFMS application to triangulate the location of the MU on a site map representative of the actual physical dimensions of the switch radio coverage area. Once located on a site map, intuitive decisions can be made regarding the MU's authorization within the switch managed network.

9. Within the Radio Settings field, configure the **Placement** of the radio as either **Indoors** or **Outdoors** (using the Placement drop-down menu). The setting will affect the channel and power levels. The default is Indoor.
10. Select a channel for communications between the access port and MUs using the **Desired Channel** drop-down menu.

    The selection of the channel determines available power levels. The range of legally approved communication channels varies depending on the installation location and country. The selected channel can be a specific channel, "Random," or "ACS." Random assigns each radio a random channel. ACS (*Automatic Channel Selection*) allows the switch to systematically assign channels. The default is Random.
11. After selecting a channel, select a power level in dBm for RF signal strength using the **Desired Power (dBm)** drop-down menu.

    The optimal power level for the specified channel is best determined by a site survey prior to installation. Available settings are determined according to the selected channel. Set a higher power level to ensure RF coverage in WLAN environments that have more electromagnetic interference or greater distances between the access port and MUs. Decrease the power level according to the proximity of other access ports. Overlapping RF coverage may cause lost packets and difficulty for roaming devices trying to connect to an access port. After setting a power level, channel and placement the RF output power for the access port is displayed in mW. Default is 20 dBm (802.11bg), 17 dBm (802.11a)**)**

NOTE After setting a power level, channel and placement, the RF output power for the access port is displayed below in mW.

12. To configure optional rate settings, click the **Rate Settings** button to display a screen containing available rate settings. Instructions on configuring rate settings is described in *Configuring Rate Settings on page 4-92*.
13. In most cases, the default settings for the **Advanced Properties** section are sufficient for most users. If needed, additional radio settings can be modified for the following properties:

Antenna Diversity	Use the drop-down menu to configure the Antenna Diversity settings for access ports using external antennas. Options include: • *Full Diversity* - Utilizes both antennas to provide antenna diversity. • *Primary Only* - Enables only the primary antenna. • *Secondary Only* - Enables only the secondary antenna. Antenna Diversity should only be enabled if the access port has two matching external antennas. Default value is **Full Diversity**
Maximum MUs	Sets the number of MUs that can associate to a radio. The maximum number is 256.
Adoption Preference ID	The Adoption Preference ID defines the preference ID of the switch.The value can be set between 1 and 65535. To make the radios preferred, the access port preference ID should be the same as adoption preference ID. The adoption preference ID is used for AP load-balancing. A switch will preferentially adopt access ports which have the same adoption-preference-ID as the switch itself.

Short Preambles only	If using a 802.11bg radio, select this checkbox for the radio to transmit using a short preamble. Short preambles improve throughput. However, some devices (SpectraLink phones) require long preambles. This checkbox does not display if using an 802.11a radio.
RTS Threshold	Specify a *Request To Send* (RTS) threshold (in bytes) for use by the WLAN's adopted access ports. RTS is a transmitting station's signal that requests a *Clear To Send* (CTS) response from a receiving station. This RTS/CTS procedure clears the air where many MUs (or nodes) are contending for transmission time. Benefits include fewer data collisions and better communication with nodes that are hard to find (or hidden) because of other active nodes in the transmission path. Control RTS/CTS by setting an RTS threshold. This setting initiates an RTS/CTS exchange for data frames larger than the threshold, and sends (without RTS/CTS) any data frames smaller than the threshold. Consider the trade-offs when setting an appropriate RTS threshold for the WLAN's access ports. A lower RTS threshold causes more frequent RTS/CTS exchanges. This consumes more bandwidth because of the additional latency (RTS/CTS exchanges) before transmissions can commence. A disadvantage is the reduction in data-frame throughput. An advantage is quicker system recovery from electromagnetic interference and data collisions. Environments with more wireless traffic and contention for transmission make the best use of a lower RTS threshold. A higher RTS threshold minimizes RTS/CTS exchanges, consuming less bandwidth for data transmissions. A disadvantage is less help to nodes that encounter interference and collisions. An advantage is faster data-frame throughput. Environments with less wireless traffic and contention for transmission make the best use of a higher RTS threshold. The default is 2346
Beacon Interval	Specify a beacon interval in units of 1,000 microseconds (K-us). This is a multiple of the DTIM value, for example, 100: 10. A beacon is a packet broadcast by adopted access ports to keep the network synchronized. Included is information such as the WLAN service area, the radio-port address, the broadcast destination addresses, a time stamp, and indicators about traffic and delivery such as a DTIM. Increase the DTIM/beacon settings (lengthening the time) to let nodes sleep longer and preserve battery life. Decrease these settings (shortening the time) to support streaming-multicast audio and video applications that are jitter-sensitive. The default is 100 K-us
Self Healing Offset	When an AP increases its power to compensate for a failed AP, power is increased to the country's regulatory maximum. Set the Self Healing Offset to reduce the country's regulatory maximum power if APs are situated close to each other or if APs use external antennas.

DTIM Periods	Select the **DTIM Periods** button to specify a period for *Delivery Traffic Indication Messages* (DTIM) for BSSIDs 1 through 4. This is a divisor of the beacon interval (in milliseconds), for example, 10 : 100. A DTIM is periodically included in the beacon frame transmitted from adopted access ports. The DTIM period determines how often the beacon contains a DTIM, for example, 1 DTIM for every 10 beacons. The highest interval permitted is 50 per BSS. The DTIM indicates broadcast and multicast frames (buffered at the access port) are soon to arrive. These are simple data frames that require no acknowledgement, so nodes sometimes miss them. Increase the DTIM/beacon setting (lengthening the time) to let nodes sleep longer and preserve their battery life. Decrease these settings (shortening the time) to support streaming-multicast audio and video applications that are jitter-sensitive.

14. Refer to the **Status** field for the current state of the requests made from applet. This field displays error messages if something goes wrong in the transaction between the applet and the switch.
15. Click **OK** to use the changes to the running configuration and close the dialog.
16. Click **Cancel** to close the dialog without committing updates to the running configuration.

Configuring Rate Settings

Use the **Rate Settings** screen to define a set of basic and supported rates for the target radio. This allows the radio to sync with networks using varying data rates and allows the radio to default to a predefined set of data rates when higher data rates cannot be maintained.

To configure a radio's rate settings:

1. Click the **Rate Settings** button in the radio edit screen to launch a screen wherein rate settings can be defined for the radio.
2. Check the boxes next to all **Basic Rates** you want supported for this radio.

   Basic Rates are used for management frames, broadcast traffic and multicast frames. If a rate is selected as a basic rate, it is automatically selected as a supported rate.
3. Check the boxes next to all **Supported Rates** supported by this radio.

Supported Rates allow an 802.11 network to specify the data rate it supports. When a station attempts to join the network, it checks the data rate used on the network. If a rate is selected as a basic rate it is automatically selected as a supported rate.

4. Click the **Clear all rates** button to uncheck all of the Basic and Supported rates.
5. Refer to the **Status** field for the current state of the requests made from applet. This field displays error messages if something goes wrong in the transaction between the applet and the switch.
6. Click **OK** to use the changes to the running configuration and close the dialog.
7. Click **Cancel** to close the dialog without committing updates to the running configuration.

4.8.2 Configuring Layer 3 Access Port Adoption

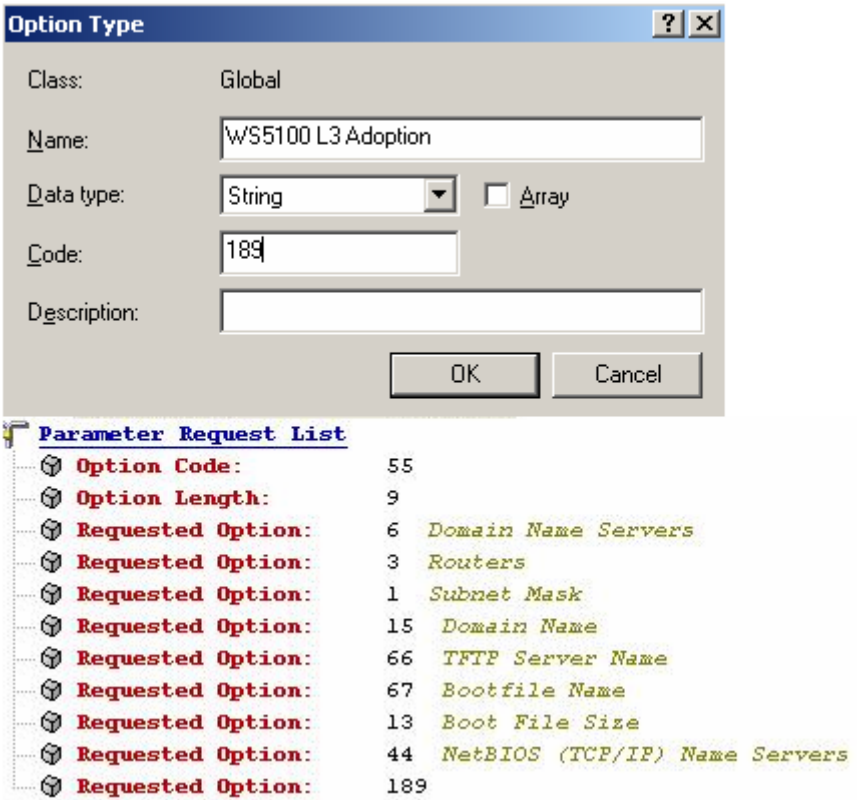
The configuration activity required for adopting access ports in a layer 3 environment is unique. In a layer 3 environment, switch discovery is attempted in the following ways:

- *On the local VLAN*
- *Through the DHCP Server*

Initially, the access port attempts to adopt its wireless switch by broadcasting a hello packet on its local VLAN. During this activity:

1. Switches on the VLAN that receive this packet respond with a parent packet.
2. If no response is received, the access port attempts to discover its switch by first obtaining an IP address from a DHCP (or DNS) server and by checking the options field within the DHCP response.

   The options field (Option 189) contains a list of switch IP addresses available for the access port.



3. The system administrator programs these options into the DHCP server.
4. If the access port finds the list, it sends a unidirectional hello packet (encapsulated in a UDP/IP frame) to each switch on the list.
5. Each switch that receives a packet responds with a parent response.

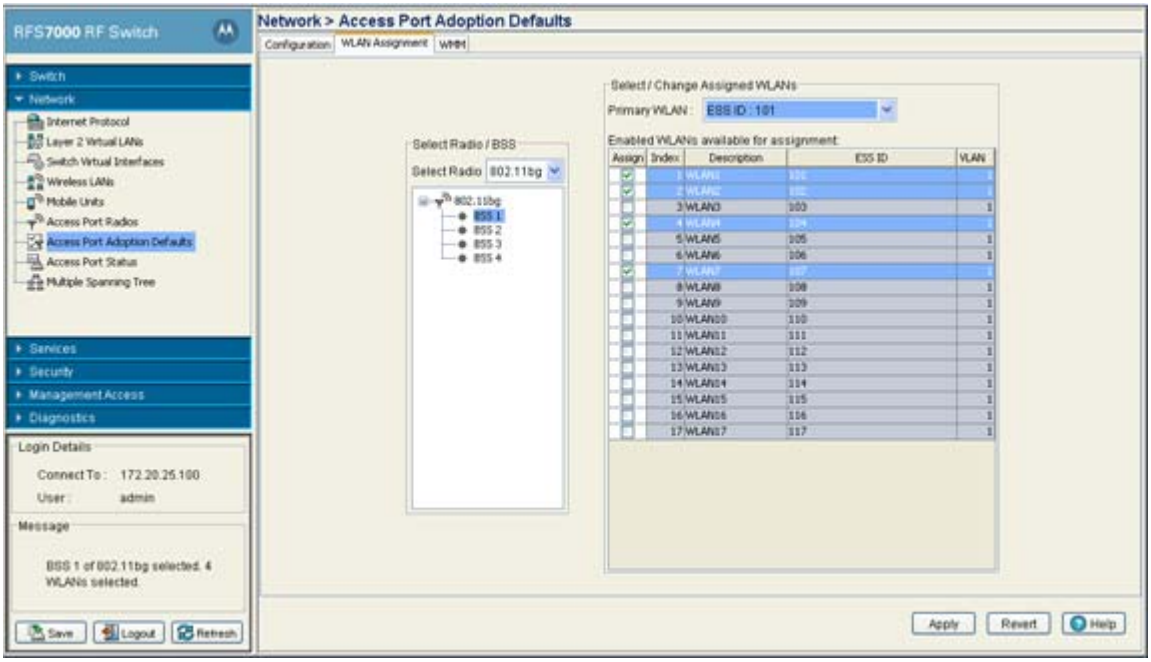
4.8.3 Configuring WLAN Assignment

Use the **WLAN Assignment** tab to assign WLANs and security schemes to existing WLAN indexes.

To view existing WLAN Assignments:

1. Select **Network > Access Port Adoption Defaults** from the main menu tree.

2. Click the **WLAN Assignment** tab.



The WLAN Assignment tab displays two fields: **Select Radios/BSS** and **Select/Change Assigned WLANs**.

3. Within the **Select Radios/BSS** field, select the radio type (802.11a or 802.11bg) from the **Select Radio** drop-down menu.
4. Select the desired BSS from the **BSS list** or select a **Radio** (802.11a or 802.11bg) to modify.
5. Refer to the **Select/Change Assigned WLAN** field for the following information:

Primary WLAN	If a specific BSS was selected from the **Select Radio/BSS** area, choose one of the selected WLANs from the drop-down menu as the primary WLAN for the BSS. If the radio was selected, the applet will automatically assign one WLAN to each BSS. The WLAN is set as the **Primary WLAN** for the BSS. If the number of WLANs selected is greater than the number of BSSIDs, the remaining WLANs are included with the last BSS.
Assign	Assign WLAN(s) to the selected BSS or Radio.
Index	Displays (in ascending order) the numerical index assigned to each SSID. Use the index (along with the WLANs name) as a means of identifying WLANs once assigned to different radio BSSIDs. A BSSID cannot support two WLANs with the same numerical index.
Description	Use the WLAN description (along with the WLANs index) as a means of identifying WLANs assigned to different radio BSSIDs. A BSSID cannot support two WLANs with the same description.
ESS ID	Displays the assigned SSID uniquely distributed between the WLANs assigned to the BSSIDs.
VLAN	Displays the VLAN ID of VLANs assigned to WLANs. By default, all WLANs are assigned to VLAN 1.

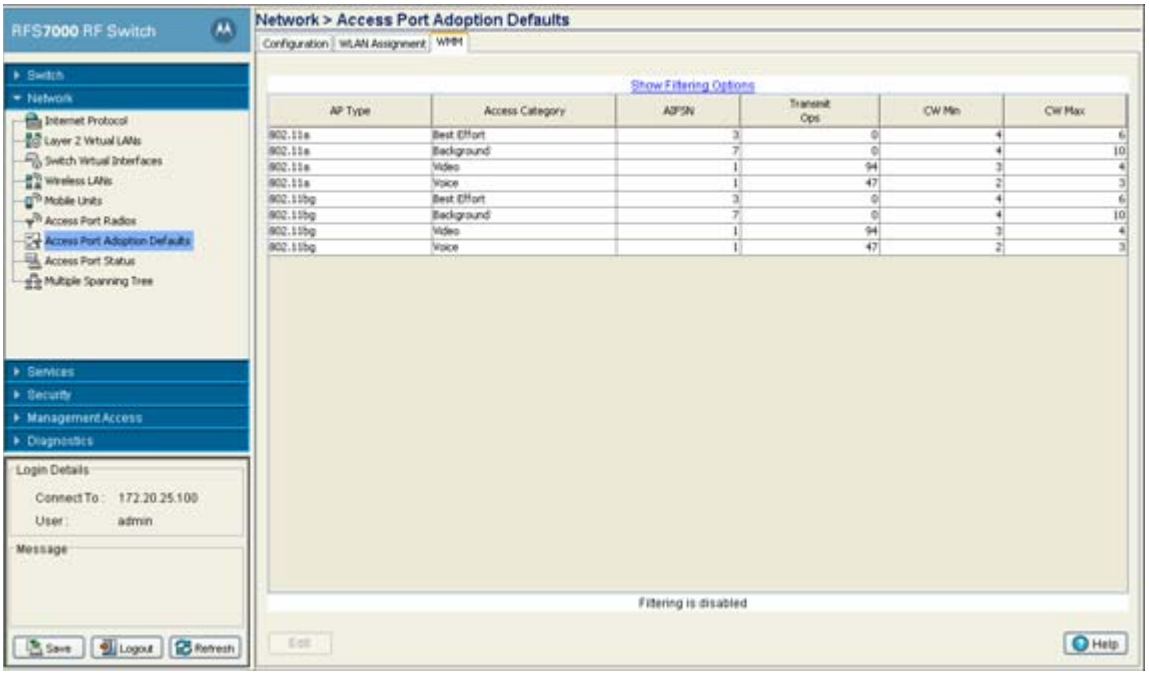
6. Click **Apply** to save the changes made within the screen.
7. Click **Revert** to cancel the changes made and revert back to the last saved configuration.

4.8.4 Configuring WMM

Use the **WMM** tab to review each radio type, as well as the Access Category that defines the data (Video, Voice, Best Effort and Background) the radio has been configured to process. Additionally, the WMM tab displays the transmit intervals defined for the target access category.

To view existing WMM Settings:

1. Select **Network** > **Access Port Adoption Defaults** from the main menu tree.
2. Select the **WMM** tab.



3. Refer to the WMM tab for the following information:

AP Type	Displays whether the radio is an 802.11a radio or an 802.11bg radio. This value is read-only and cannot be modified.
Access Category	Displays the Access Category currently in use. There are four categories: Video, Voice, Best Effort and Background. Click the Edit button to change the current Access Category. Ensure the Access Category reflects the radio's intended network traffic.
AIFSN	Displays the current *Arbitrary Inter-frame Space Number* (AIFSN). Higher-priority traffic categories should have lower AIFSNs than lower-priority traffic categories. This causes lower-priority traffic to wait longer before trying to access the medium.
Transmit Ops	Displays the maximum duration a device can transmit after obtaining a transmit opportunity. For higher-priority traffic categories, this value should be set higher.

CW Min	The CW Min is combined with the CW Max to define the Contention Window. From this range, a random number is selected for the back off mechanism. Lower values are used for higher priority traffic.
CW Max	The CW Max is combined with the CW Min to make the Contention Window. From this range, a random number is selected for the back off mechanism. Lower values are used for higher priority traffic.

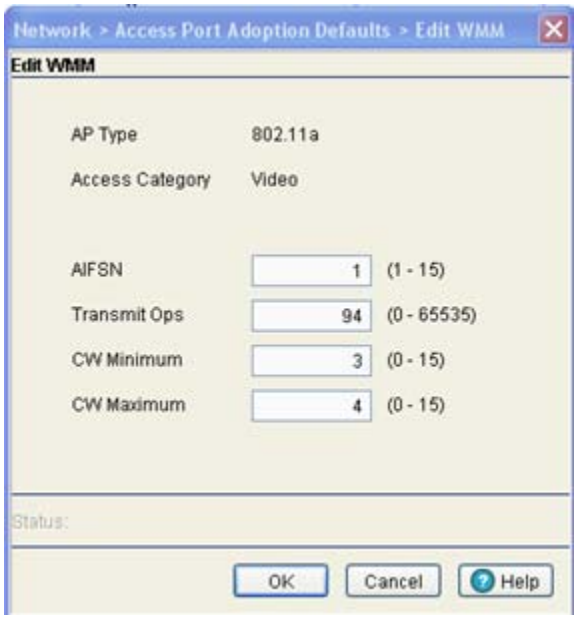
4. To modify the properties of WMM Adoption Settings, select a radio and click the Edit button. For more information, see *Editing Access Port Adoption WMM Settings on page 4-116*.

4.8.4.1 Editing Access Port Adoption WMM Settings

Use the **Edit** screen to modify a WMM profile's properties (AIFSN, Transmit Ops, Cw Min and CW Max). Modifying these properties may be necessary as Access Categories are changed and transmit intervals need adjustment to compensate for larger data packets and contention windows.

To edit the existing WMM settings:

1. Select **Network > Radio Adoption Defaults** from the main menu tree.
2. Click the **WMM** tab.
3. Select a radio from the table and click the **Edit** button.



The **AP Type** identifies whether the radio is an 802.11a radio or an 802.11 bg radio. This value is read-only and cannot be modified. There are four editable access categories: Video, Voice, Best Effort and Background.

4. Enter a number between 0 and 15 for the **AIFSN** value for the selected radio.

   The AIFSN value is the current *Arbitrary Inter-frame Space Number*. Higher-priority traffic categories should have lower AIFSNs than lower-priority traffic categories. This causes lower-priority traffic to wait longer before trying to access the medium.

5. Enter a number between 0 and 65535 for the **Transmit Ops** value.

The Transmit Ops value is the maximum duration a device can transmit after obtaining a transmit opportunity. For Higher-priority traffic categories, this value should be set higher.

6. Enter a value between 0 and 15 for the **Contention Window minimum** value.

   The CW Minimum is combined with the CW Maximum to make the Contention Window. From this range, a random number is selected for the back off mechanism. Lower values are used for higher priority traffic.

7. Enter a value between 0 and 15 for the **Contention Window maximum** value.

   The CW Maximum is combined with the CW Minimum to make the Contention Window. From this range, a random number is selected for the back off mechanism. Lower values are used for higher priority traffic.

8. Refer to the **Status** field for the current state of the requests made from applet. This field displays error messages if something goes wrong in the transaction between the applet and the switch.
9. Click **OK** to use the changes to the running configuration and close the dialog.
10. Click **Cancel** to close the dialog without committing updates to the running configuration.

4.9 Viewing Access Port Status

Use the **Access Port Status** screen to view device hardware address and software version information for adopted and unadopted access ports. The Access Port Status screens is partitioned into two tabs supporting the following status activities:

- *Viewing Adopted Access Ports*
- *Viewing Unadopted Access Ports*

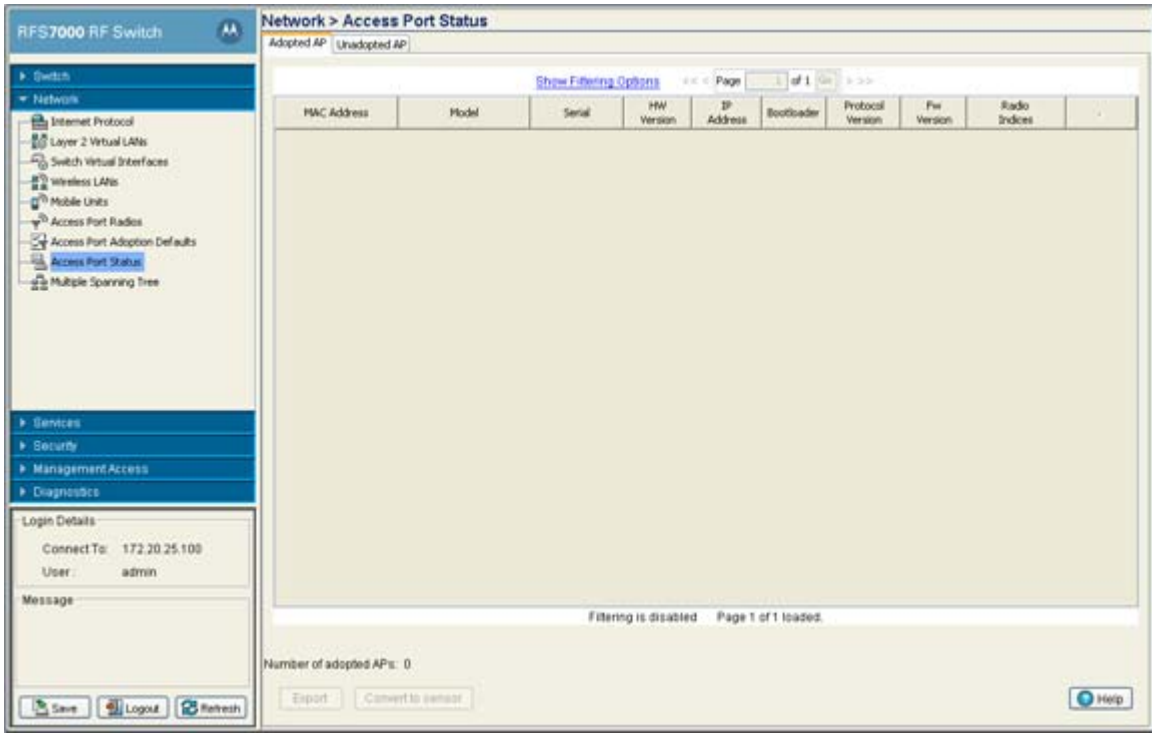
4.9.1 Viewing Adopted Access Ports

Use the **Adopted AP** tab for gathering device hardware address and software version information for the access port. Use this information to determine whether the access port's version supports the optimal feature set available for the network.

To view existing adopted access port information:

1. Select **Network** > **Access Port Status** from the main menu tree.

2. Click the **Adopted AP** tab.



3. Refer to the **Adopted AP** screen for the following information:

MAC Address	Displays the radio's first MAC address when it is adopted by the switch.
Model	Displays the model number of the access port.
Serial	Displays the serial number of the access port, and is used for switch management purposes. It is read-only and cannot be modified.
HW Version	Displays the hardware version of the access port. This information can be helpful when troubleshooting problems with the access port.
IP Address	Displays the IP address of the adopted access port.
Bootloader	Displays the software version the access port boots from. This information can be helpful when troubleshooting problems.
Protocol Version	Displays the version of the interface protocol between the access port and the switch. This information can be helpful when troubleshooting problems with the access port.
Fw Version	Displays the access port firmware version at run time. Use this information to assess whether the software requires an upgrade for better compatibility with the switch.
Radio Indices	Displays the indices of the radios belonging to the selected access port. These indices are equivalent to a numerical device recognition identifier (index) for the radio.

4. Click the **Export** button to export the contents of the table to a Comma Separated Values file (CSV).

5. Click the **Convert to Sensor** button to convert the selected adopted AP to a sensor that can be used with the *Wireless Intrusion Protection System* (WIPS) application.

   WIPS uses sensors to collect data transmitted by 802.11a and 802.11b/g compliant devices and sends the data to a centralized server for analysis and correlation. Sensors are passive devices that function primarily in listen-only mode. A single sensor can monitor multiple APs.

   Once the sensor collects wireless LAN data, the centralized server analyzes the 802.11 frames and extracts meaningful data points to determine key attributes, such as:

   - *Wireless device associations*
   - *Use of encryption and authentication*
   - *Vendor identification of all devices*
   - *Total data transferred*

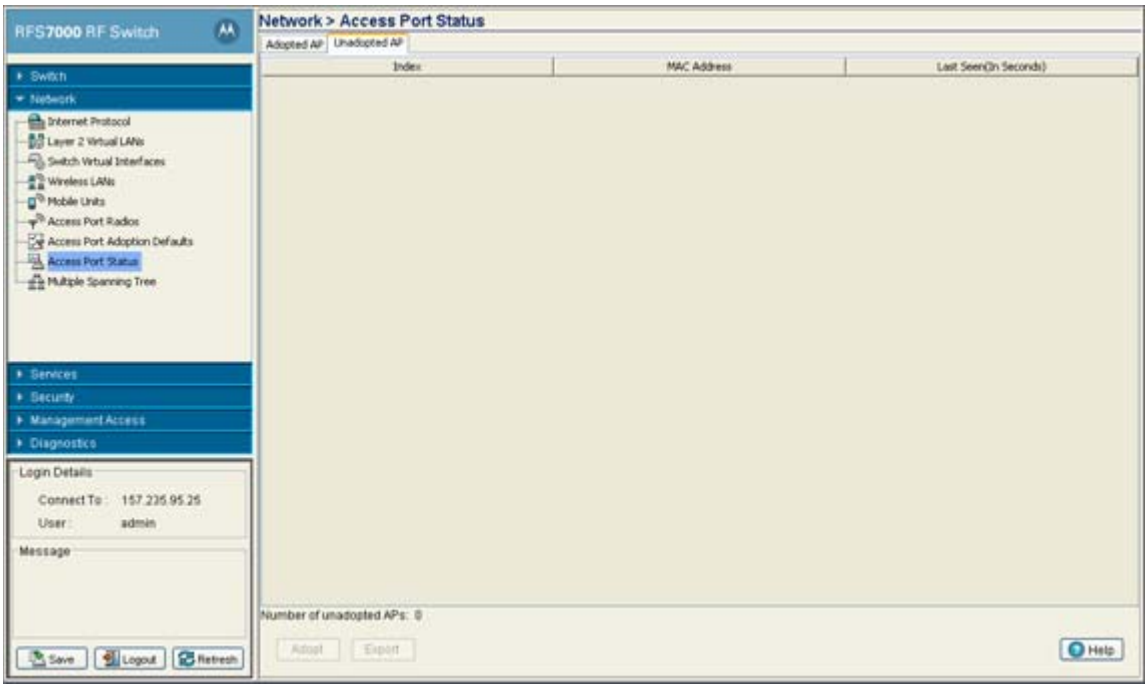
   Preprocessing data centrally ensures a reduced reliance on network bandwidth to perform wireless network management.

4.9.2 Viewing Unadopted Access Ports

Use the **Unadopted AP** tab for gathering device hardware address and software version information for the access port.

To view existing Radio Configuration information:

1. Select **Network > Access Port Status** from the main menu tree.
2. Click the **Unadopted AP** tab.



The **Unadopted AP** tab displays the following information:

Index	Displays a numerical identifier used to associate a particular access port with a set of statistics and can help differentiate the access port from other access ports with similar attributes.

MAC Address	Displays the unique Hardware or *Media Access Control* (MAC) address for the access port. Access ports with dual radios will have a unique MAC address for each radio. The MAC address is hard coded at the factory and cannot be modified.
Last Seen (In Seconds)	Displays the time the access port was last seen (observed within the switch managed network). This value is expressed in seconds. Use this value to assess if the access port is no longer in communications with the switch.
Number of Unadopted APs	Displays the total number of access ports (at the bottom of the screen) that have been recognized, but not adopted by the switch.

3. Select an available index and click the **Adopt** button to display a screen wherein the properties of a new radio can be added for adoption to the switch. When displayed, the screen prompts for the MAC address and type of radio. Complete the fields and click the **OK** button to add the radio.
4. Click the **Export** button to export the contents of the table to a *Comma Separated Values* file (CSV).

CAUTION An access port is required to have a DHCP provided IP address before attempting layer 3 adoption, otherwise it will not work. Additionally, the access port must be able to find the IP addresses of the switches on the network. To locate switch IP addresses on the network:

- Configure DHCP option 189 to specify each switch IP address.
- Configure a DNS Server to resolve an existing name into the IP of the switch. The access port has to get DNS server information as part of its DHCP information. The default DNS name requested by an AP300 is "Symbol-WISPE-Address". However, since the default name is configurable, it can be set as a factory default to whatever value is needed.

4.10 Multiple Spanning Tree

Multiple Spanning Tree (MST) protocol provides a VLAN-aware protocol and algorithm to create and maintain a loop-free network. It allows the configuration of multiple spanning tree instances. This ensures a loop-free topology for 1 or more VLANs. It allows the network administrator to provide a different path for each group of VLANs to better utilize redundancy.

MST uses *Rapid Spanning Tree* (RST) protocol for rapid convergence. Since MST allows VLANs to be grouped in an instance, each instance can have its own spanning-tree topology of other spanning-tree instances. This architecture provides multiple forwarding links for data traffic, load balancing and therefore, reduces the number of spanning-tree instances required to support a large number of VLANs.

Using MST, the network can be divided into regions. All switches within a region use the same VLAN to utilize instance mapping. The entire network runs a spanning tree instance called the *common spanning tree* instance (CST) that interconnects regions as well as legacy (STP and RSTP) bridges. The regions run on a local instance for each configured MST instance.

The local spanning tree for instance 0 is known as *Internal Spanning Tree* (IST). The *Common and Internal Spanning Tree* (CIST) (which consists of the CST as well as all ISTs across regions) interconnects all bridges in the network. With the exception of provisions for multiple instances, MST operates exactly like RSTP.

The following definitions describe the STP instances that define an MST configuration:

- *Common Spanning (CST)* – MST runs a single spanning tree instance (called the *Common Spanning Tree*) that interconnects all the bridges in a network. This instance treats each region as a single bridge. In all other ways, it operates exactly like *Rapid Spanning Tree* (RSTP).
- *Common and Internal Spanning Trees (CIST)* – CIST contains all of the ISTs and bridges not formally configured into a region. This instance interoperates with bridges running legacy STP and RSTP implementations.
- *Multiple Spanning Tree Instance (MSTI)* – The MSTI is identified by an *MST identifier* (MSTid) value from 1 and 15. This defines an individual instance of a spanning tree. One or more VLANs can be assigned to an MSTI. A VLAN cannot be assigned to multiple MSTIs. The multiple spanning tree instance 0 is always present. VLANs not explicitly assigned to an instance are assigned to instance 0.
- *MSTP Region* – These are clusters of bridges that run multiple instances of the MST protocol. Multiple bridges detect they are in the same region by exchanging their configuration (instance to VLAN mapping), name, and revision-level. If you need to have two bridges in the same region, the two bridges must have identical configurations, names, and revision-levels.

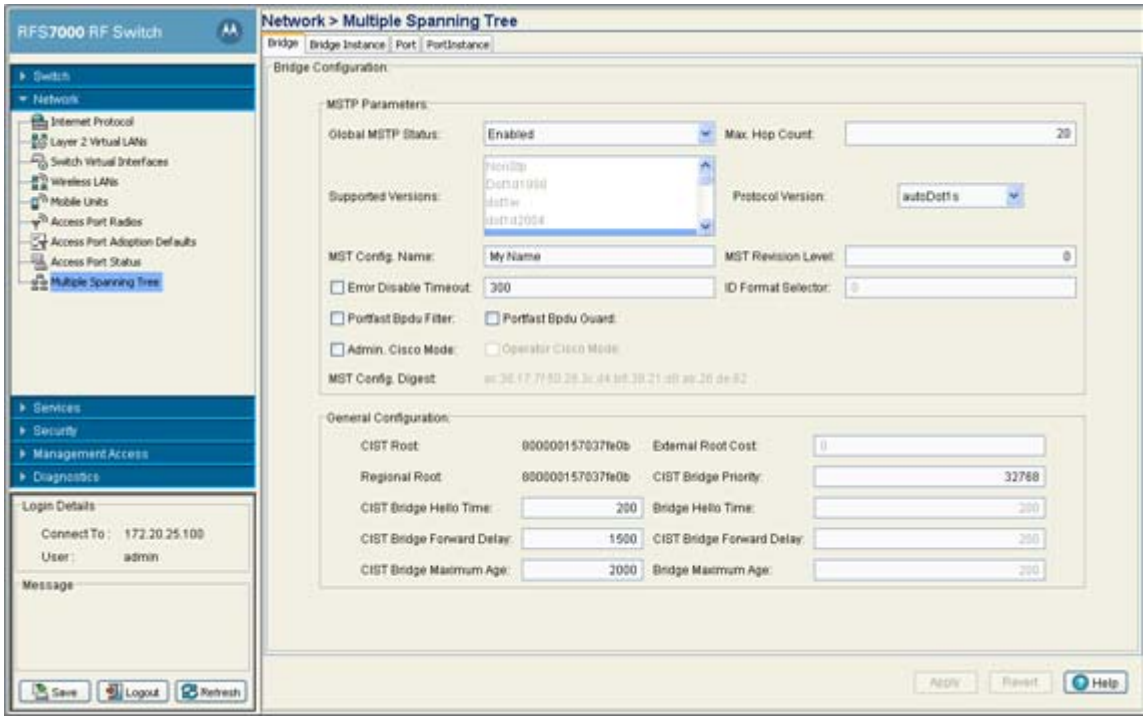
To configure the switch for MST support, configure the name and the revision on each switch being configured. This name is unique to each region. Then create an Instance and assign an ID. VLANs are then assigned to instances. These instances must be configured on switches that interoperate with the same VLAN assignments. Port cost, priority and global parameters can then be configured for individual ports and instances.

The Multiple Spanning Tree option contains separate tabs for the following activities:

- *Configuring a Bridge*
- *Viewing and Configuring Bridge Instance Details*
- *Configuring a Port*
- *Viewing and Configuring Port Instance Details*

4.10.1 Configuring a Bridge

Use the **Bridge** tab to configure the Bridge. This window displays bridge configuration details for the switch.



To configure the MSTP bridge:

1. Select **Network** > **Multiple Spanning Tree** from the main menu tree.
2. Select the **Bridge** tab (should be the displayed tab by default).
3. Refer to the MSTP Parameter field to view or set the following:

Global MSTP Status	Use the drop-down menu to define MSTP status. The default is Enabled.
Max Hop Count	Displays the maximum allowed hops for a BPDU (*Bridge Protocol Data Unit)* in an MST region. This value is used by all the MST instances.
Supported Versions	Displays the different versions of STP supported.
Protocol Version	Use the drop-down menu to select one of the following options available MST protocol options: • *forceNonStp* • *forceLegacyDot1d* • *forceDot1w* • *autoDot1s* • *unknown*
MST Config. Name	Enter a name for the MST instance. Each switch running MST is configured with a unique MST name. This helps when the switch has different VLANs that belong to different MST regions.

MST Revision Level	Assign a MST revision level number to the MST region to which the device belongs. Each switch running is configured with a unique MST name and revision number. This helps when the switch has different VLANs that belong to different MSTP regions. The MST Revision Level specifies the revision level MSTP.
Error Disable Timeout	Select this option to enable an error disable-timeout facility. The error disable-timeout is used to set a timeout value for ports disabled resulting from a BPDU guard. The BPDU guard feature shuts down the port on receiving a BPDU on a BPDU-guard enabled port.
ID Format Selector	Enter the format selector value of the Configuration Identifier.
Portfast Bdpu Filter	Select this checkbox to enable a portfast BPDU filter for the port. The Spanning Tree Protocol sends BPDUs from all the ports. Enabling the BPDU filter feature ensures PortFast enabled ports do not transmit or receive any BPDUs.
PortFast Bdpu Guard	Select this checkbox to enable the PortFast BPDU Guard on the bridge. When the BPDU Guard feature is set for bridge, all portfast-enabled ports of the bridge that have BPDU set to default shutdown the port on receiving a BPDU. Hence no BPDUs are processed.
Admin Cisco Mode	Select this checkbox to enable interoperability with Cisco's version of MSTP, which is incompatible with standard MSTP.
Operator Cisco Mode	Displays whether Cisco's version of MSTP is running. This is not a configurable parameter.
MST Config Digest	Displays the Configuration Digest derived from the MST Configuration table.

4. Refer to the **General Configuration** field for the following

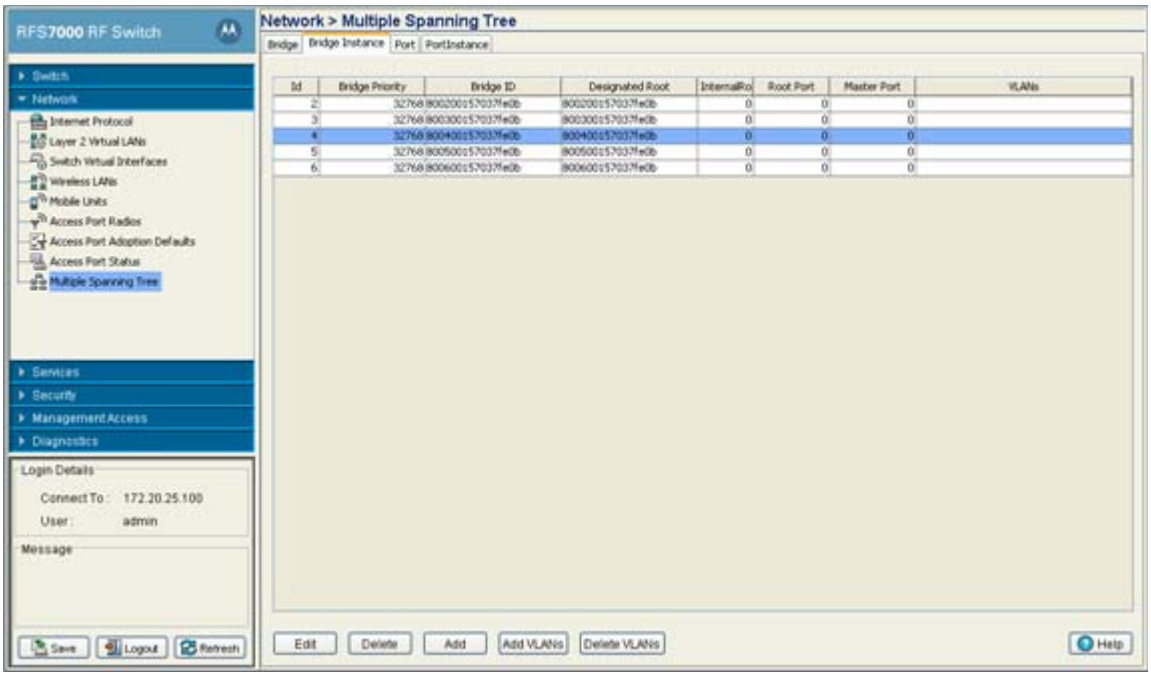
CIST Root	This displays the *CIST* (*Common Internal Spanning Tree*) root MAC address. The CIST root is the master region to which other root regions are associated. The lower the path cost, the greater the likelihood of the bridge becoming the root.
External Root Cost	Displays the root cost of the CIST root.
Regional Root	This displays the regional roots MAC address.
CIST Bridge Priority	Set the bridge priority for the common instance. The value entered, determines the likelihood the instance is selected as the root. The lower the priority the greater the likelihood of the bridge becoming a root.

CIST Bridge HelloTime	Set the CIST Hello Time (in seconds). After the defined interval all bridges in a bridged LAN exchange BPDUs. The hello time is the time interval (in seconds) the device waits between BPDU transmissions. If this is the root bridge, the value is equal to the configured Hello Time. A very low value leads to excessive traffic on the network, whereas a higher value delays the detection of a topology change. This value is used by all instances.
Bridge Hello Time	Displays the configured Hello Time.
CIST Bridge Forward Delay	Enter the CIST bridge forward delay value received from the root bridge. If this is the root bridge, the value will be equal to the Configured Forward Delay. The forward delay value is the maximum time (in seconds) the root device waits before changing states (from a listening state to a learning state to a forwarding state). This delay is required, as every device must receive information about topology changes before forwarding frames. In addition, each port needs time to listen for conflicting information that would make it return to a blocking state; otherwise, temporary data loops may result.
CIST Bridge Forward Delay	Displays the configured forward delay period.
CIST Bridge Maximum Age	Enter the CIST bridge maximum age received from the root bridge. If this is the root bridge, the value will be equal to the Configured Max Age.
Bridge Maximum Age	Enter the bridge maximum value. The max-age is the maximum time (in seconds) for which (if a bridge is the root bridge) a message is considered valid. This prevents the frames from looping indefinitely. The max-age should be greater than twice the value of hello time plus one, but less than twice the value of forward delay minus one. The allowable range for max-age is 6-40 seconds. Configure this value sufficiently high, so a frame generated by root can be propagated to the leaf nodes without exceeding the max-age.

4.10.2 Viewing and Configuring Bridge Instance Details

The Bride Instance tab displays the number of MST instance created and VLANS associated with it. To view and configure the MSTP bridge instance:

1. Select **Network** > **Multiple Spanning Tree** from the main menu tree.
2. Select the **Bridge Instance** tab.



The Bridge Instance tab displays the following:

ID	Displays the ID of the MST instance.
Bridge Priority	Displays the bridge priority for the associated instance. The Bridge Priority is assigned to an individual bridge based on whether it is selected as the root bridge. The lower the priority, the greater likelihood the bridge becoming the root.
Bridge ID	Displays the MAC address of the bridge.
Designated Root	Displays the ID of the root bridge that sent the BPDU received on this port.
Internal Root Cost	Displays the configured path cost on a link connected to this port within the internal MSTP region.
Root Port	Displays the MAC address of the root port.
Master Port	Displays the MAC address of the master port.
VLANs	Displays the number of VLANs included in this MSTP instance.

3. Select an ID and click the **Delete** button to remove from the list.

4.10.2.1 Creating a Bridge Instance

To create a VLAN instance and associate it with a bridge as a numerical identifier:

1. Select **Network** > **Multiple Spanning Tree** from the main menu tree.

2. Select the **Bridge Instance** tab.
3. Click the **Add** button.

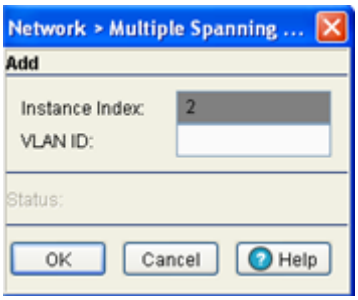
4. Enter a value between 1 and 15 as the Instance ID.
5. Click **OK** to save and commit the changes.

   The Bridge Instance tab with now display the new instance ID.
6. Click **Cancel** to disregard the new Bridge Instance ID.

4.10.2.2 Associating VLANs to a Bridge Instance

To associate VLANs to a bridge instance:

1. Select **Network** > **Multiple Spanning Tree** from the main menu tree.
2. Select the **Bridge Instance** tab.
3. Select an ID from the table within the Bridge Instance tab and click on the **Add VLAN**s button.



4. Enter a VLAN ID between 1 to 4094 in the VLAN ID field. This VLAN ID is associated with the Instance index. You can add multiple VLANs to an instance.
5. Click **OK** to save and commit the new configuration.
6. Click **Cancel** to disregard the changes.

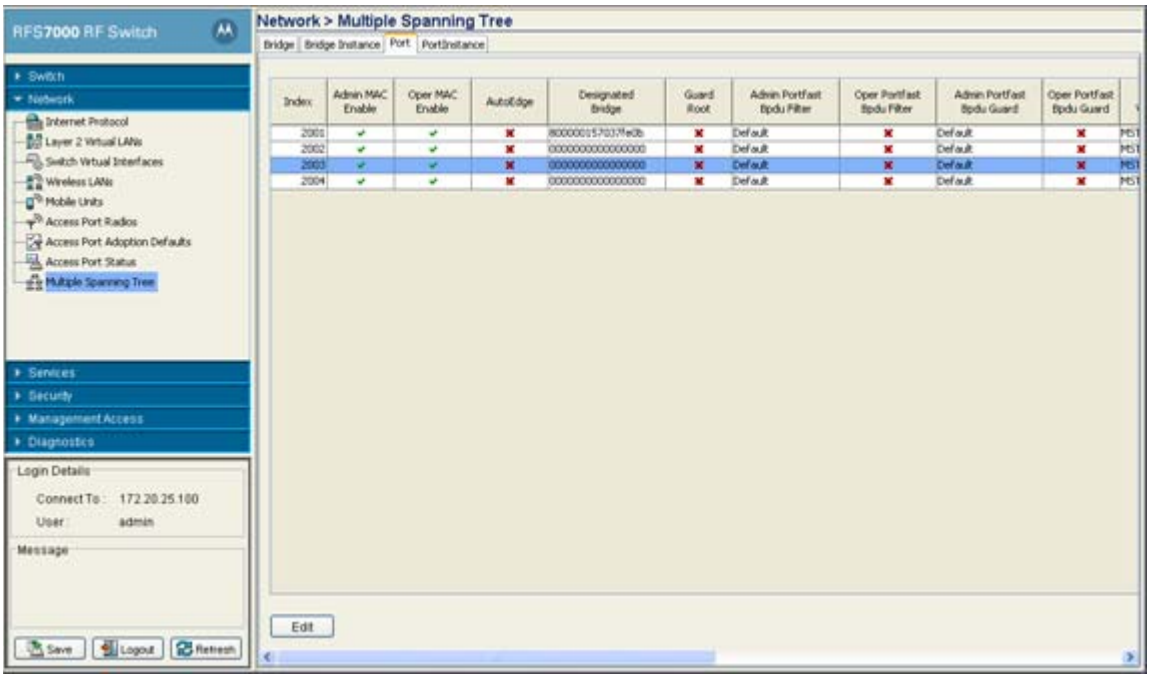
4.10.3 Configuring a Port

Use the **Port** tab to view and configure MST port parameters, including enabling/disabling the spanning tree algorithm on one or more ports (displaying the designated bridge and port/root information).

To view and configure MSTP port details:

1. Select **Network** > **Multiple Spanning Tree** from the main menu tree.

2. Select the **Port** tab



The **Port** tab displays the following information (ensure you scroll to the right to view the numerous port variables described):

Index	Displays the port index.
Admin MAC Enable	Displays the status of the Admin MAC. Change the status using the **Edit** button. A green check mark indicates the Admin MAC Enable status is active/enabled.
Oper MAC Enable	This field displays the status of the Oper MAC Enable. You can change the status using the **Edit** button. A green check mark indicates the Oper MAC Enable status is active/enabled.
AutoEdge	Displays whether the port is configured as an operational edge port.
Designated Bridge	Displays the ID of the bridge sent the best BPDU received on this port.
Guard Root	Displays whether the listed port index enforces root bridge placement. The guard root ensures the port is a designated port. Typically, each guard root port is a designated port, unless two or more ports (within the root bridge) are connected together. If the bridge receives superior (BPDUs) on a guard root-enabled port, the guard root moves the port to a root-inconsistent STP state. This state is equivalent to a listening state. No data is forwarded across the port. Thus, the guard root enforces the root bridge position.
AdminPort PortFast BPDU Filter	Displays the portfast BPDU filter for the admin port. The Spanning Tree Protocol sends BPDUs from all ports. Enabling the BPDU Filter ensures PortFastenabled admin ports do not transmit or receive BPDUs.

OperPort PortFast Bpdu Filter	Displays a portfast BPDU filter for the oper port. The Spanning Tree Protocol sends BPDUs from all ports. Enabling the BPDU Filter feature ensures PortFastenabled oper ports do not transmit or receive BPDUs.
AdminPort PortFast Bpdu Guard	Displays the AdminPort PortFast BPDU Guard feature. When set for a bridge, all portfast-enabled ports having the bpdu-guard set to default shut down the port on receiving the BPDU. When this occurs, the BPDU is not processed.
OperPort PortFast Bpdu Guard	Displays the OperPort PortFast BPDU Guard feature. When the OperPort PortFast BPDU Guard feature is set for a bridge, all portfast-enabled ports that have the bpdu-guard set to default shut down the port on receiving a BPDU. When this occurs, the BPDU is not processed.
Port Version	Displays the port version associated with this instance. It can be either of the following: • *STP* • *Reserved* • *RSTP* • *MSTP*
Port State	Displays whether each port listed is disabled (not forwarding MST frames) or in a forwarding mode. A port must be enabled to be able to forward. For information on enabling a port, see *Configuring a Port on page 4-126*.
Port Enable	Displays the enable/disable MST designation of each port. A green check mark indicates the Oper MAC Enable status is active/ enabled. A green checkmark should coincide with a port state of "forwarding" and a red "X" should coincide with a port state of disabled.
Port Path Cost	Displays the path cost for the specified port index. According to the original specification, cost is 1,000 Mbps (1 gigabit per second) divided by the bandwidth of the segment connected to the port. Therefore, a 10 Mbps connection would have a cost of (1,000/10) 100.
Port Designated Cost	Displays the port cost for each port on the switch. The cost helps determine the role of the port in the MST network. The designated cost is the cost for a packet to travel from this port to the root in the MST configuration. The slower the media, the higher the cost.
Designated Port	Defines the port connection used to send and receive packets. By having only one designated port per segment, all looping issues should be resolved. Once the designated port has been selected, any other ports that connect to that segment become non-designated ports and block traffic from taking the defined path.
Forward Transitions	Displays the number of frames received on this port and forwarded by the switch.

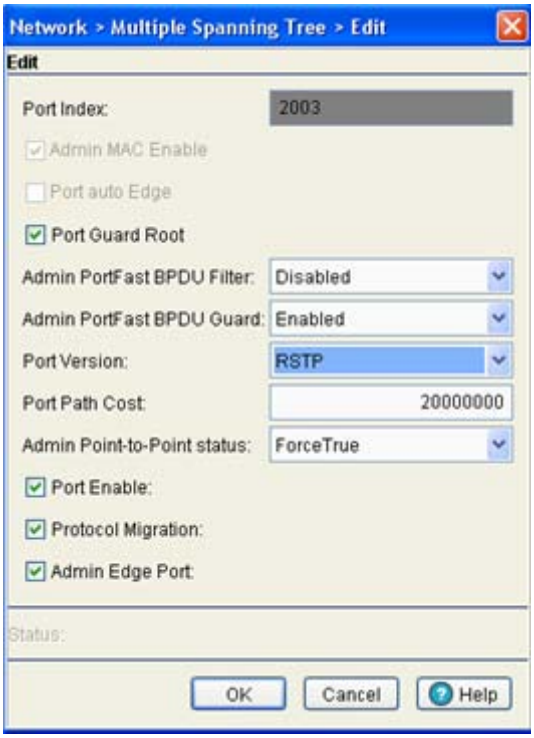
Protocol Migration	If enabled, protocol migration enables the switch (when running MST) to interoperate with legacy 802.1d switches. If the listed index receives a legacy 802.1D configuration BPDU, it only sends 802.1D BPDUs over its port. A green checkmark defines the listed index as supporting protocol migration, and a red "X" defines the listed index as having protocol migration disabled.
Admin Edge Port	A green checkmark defines the listed index enabled as an Admin Edge Port, and a red "X" defines the listed index as not being an Admin Edge Port.
Oper Edge Port	An oper edge port transitions MST data into a forwarding state. Enable it only on ports that connect to a single location. A green checkmark defines the listed index enabled as an Oper Edge Port, and a red "X" defines the listed index as not being an Oper Edge Port.
Admin Point-to-Point	Displays the point-to-point status as ForceTrue or ForceFalse. ForceTrue indicates this port should be treated as connected to a point-to-point link. ForceFalse indicates this port should be treated as having a shared connection.
Oper Point-to-Point	Displays whether the listed port index is configured to connect to another port through a point-to-point link. If enabled, the port index becomes a designated port. The designated port negotiates a rapid transition with the other port using a proposal-agreement handshake for a loop-free topology. A green checkmark defines the listed index as supporting point-to-point, and a red "X" defines the listed index as having point-to-point disabled.

3. Select an Id and click the **Edit** button to revise the selected MST port configuration. For more information, see *Editing a MST Port Configuration*.

4.10.3.1 Editing a MST Port Configuration

To edit and reconfigure MSTP Port parameters.

1. Select a row from the port table and click the **Edit** button.



The following MST Port parameters can be reconfigured.

Port Index	Displays the read-only Port Index.
Admin MAC Enable	Displays the status of the Admin MAC Enable. A green check mark indicates the status as enabled and a red X indicates the status as disabled.
Port auto Edge	Select the checkbox to use the port as an operational edge port.
Port Guard Root	Select this checkbox to support guard root for this port index. Guard root ensures the port is a designated port. Typically, each guard root port is a designated port, unless two or more ports (within the root bridge) are connected together. If the bridge receives superior (BPDUs) on a guard root-enabled port, the guard root moves the port to a root-inconsistent STP state. This state is equivalent to a listening state. No data is forwarded across the port. Thus, the guard root enforces the root bridge position.
PortFast BPDU Filter	Enable this option to change the status of the *Port Fast BPDU Filter.*
Port FastBPDU Guard	Enable this option to change the status of the *Port Fast BPDU Guard.*
Port Version	Select a value to reconfigure the port version.

Port Path Cost	Define the path cost for the specified port index. The cost is 1,000 Mbps (1 gigabit per second) divided by the bandwidth of the segment connected to the port. Therefore, a 10 Mbps connection would have a cost of (1,000/10) 100.
Admin Point-to-Point status	Define the point-to-point status as ForceTrue or ForceFalse. ForceTrue indicates this port should be treated as connected to a point-to-point link. ForceFalse indicates this port should be treated as having a shared connection.
Port Enable	Select this checkbox to use this port for the forwarding of MST supported packets on the switch.
Port Migration	If enabled, protocol migration enables the switch (when running MST) to interoperate with legacy 802.1d switches. If the listed index receives a legacy 802.1D configuration BPDU, it only sends 802.1D BPDUs over its port.
Admin Edge Port	Select the checkbox to define this port index as an admin edge port.

2. Click on **OK** button to save and commit the new configuration.
3. Click **Cancel** to disregard the changes and revert back to the previous configuration.

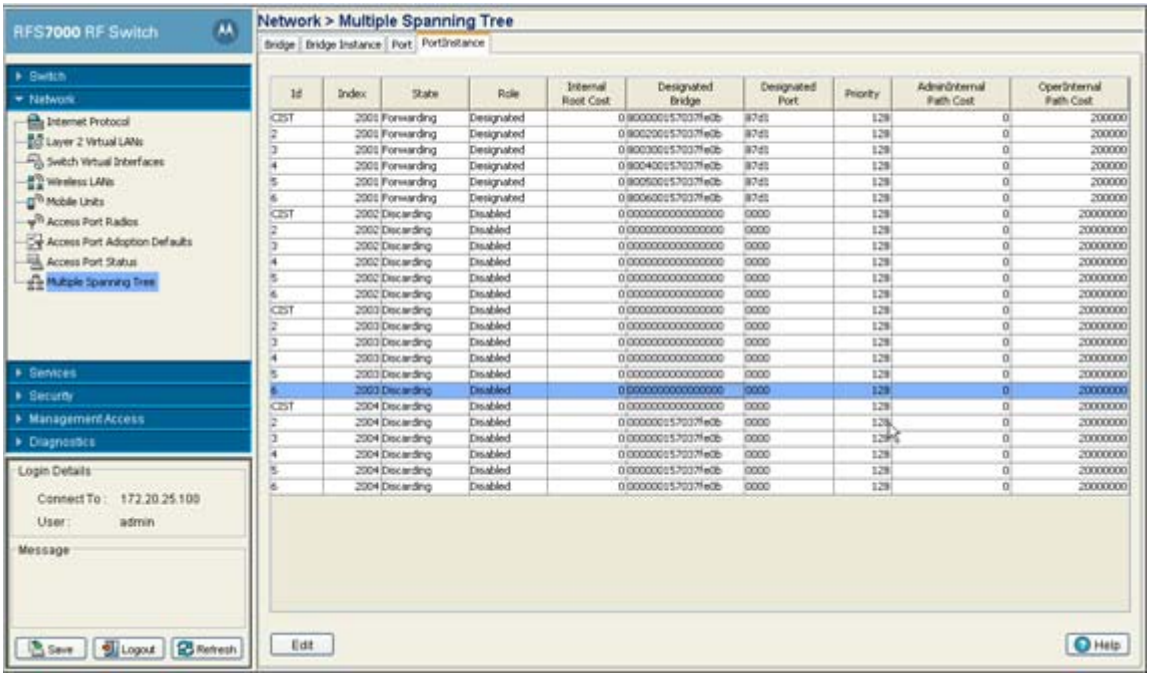
4.10.4 Viewing and Configuring Port Instance Details

Use the **Port Instance** tab to view and configure MST port instance parameters, including Port Priority and Admin Internal Path Cost.

To view and configure the MSTP bridge instance:

1. Select **Network** > **Multiple Spanning Tree** from the main menu tree.

2. Select the **PortInstance** tab.



The Port Instance table displays the following:

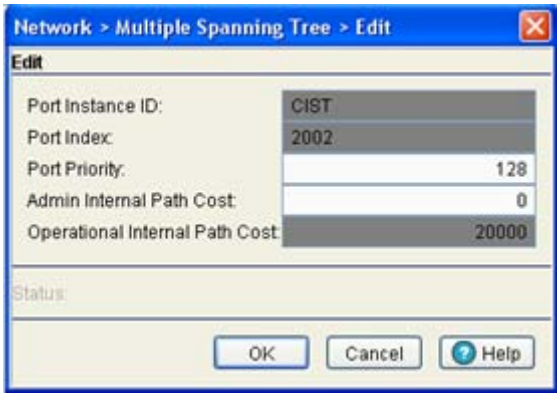
ID	Displays the port instance ID.
Index	Displays the port index.
State	Displays the availability status of the port.
Role	Displays the state of the port. It can be either **Enabled** or **Disabled**.
Internal Root Cost	Displays the Internal Root Cost of a path associated with an interface. The lower the path cost, the greater likelihood of the interface becoming the root.
Designated Bridge	Displays the ID of the bridge that sent the best BPDU.
Designated Port	Displays the ID of the port that sent the best BPDU received on this port.
Priority	Displays the port priority set for the bridge. The lower the path cost, the greater likelihood of the bridge becoming the root.
AdminInternal Path Cost	Displays the Admin Internal Root Cost of an associated path. The lower the path cost, the greater likelihood of the interface becoming the root.
OperInternal Path Cost	Displays the Operational Internal Root Cost of a path associated with an interface. The lower the path cost, the greater likelihood of the interface becoming the root.

3. If necessary, select a CIST Index from the table and click on **Edit** button to change the port priority and internal path cost value. For additional information, see *Editing a Port Instance Configuration on page 4-133*.

4.10.4.1 Editing a Port Instance Configuration

To edit and reconfigure Port Instance parameters.

1. Select a row from the port table and click the **Edit** button.



Most of the MST Port Instance parameters can be reconfigured, as indicated below.

Port Instance ID	Read only indicator of the instance ID used as a basis for other modifications.
Port Index	Read only indicator of the port index used as a basis for other modifications.
Port Priority	If necessary, change the port priority value for the bridge. The lower the priority, a greater likelihood of the bridge becoming a root.
Admin Internal Path Cost	If necessary, change the value for the Admin Internal Root Cost of a path associated with an interface. A lower the path cost, the greater likelihood of the specific interface becoming a root.
Operational Internal Path Cost	Displays the Operational Internal Root Cost of a path associated with an interface. A lower the path cost, the greater likelihood of the specific interface becoming a root.

5

Switch Services

This chapter describes the Services main menu information available for the following switch configuration activities.

- *Displaying the Services Interface*
- *DHCP Server Settings*
- *Configuring Secure NTP*
- *Configuring Switch Redundancy*
- *Layer 3 Mobility*
- *Configuring Self Healing*
- *Configuring Switch Discovery*
- *Configuring SOLE Support*

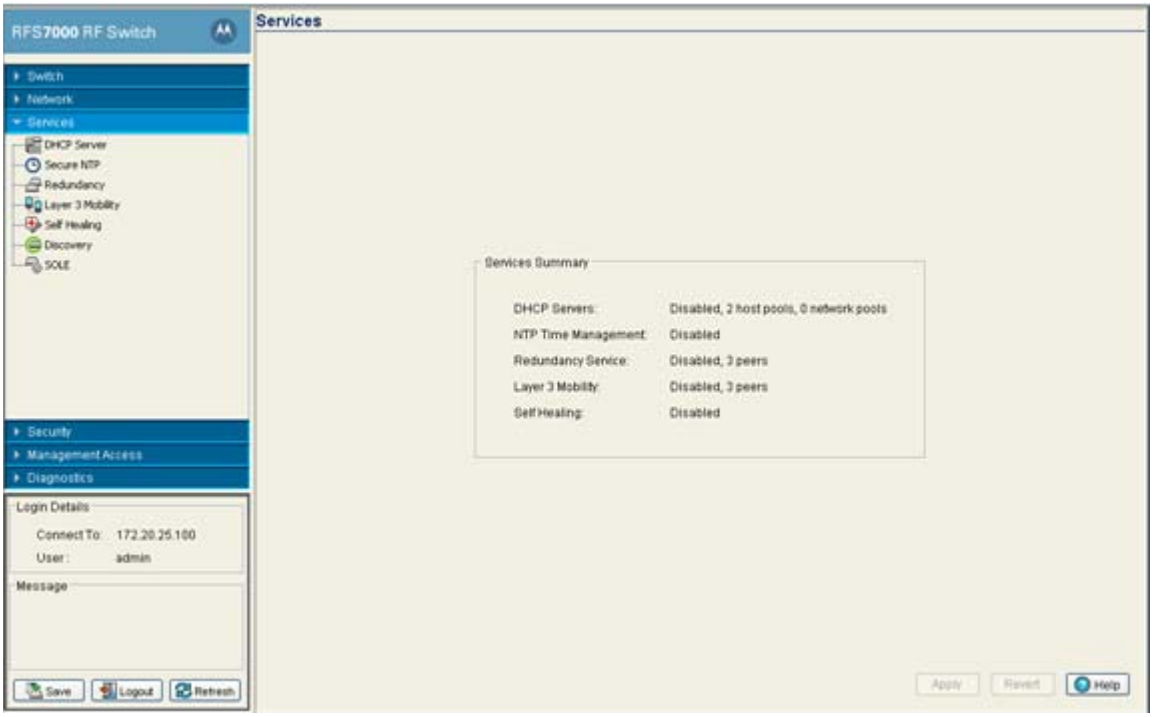
5.1 Displaying the Services Interface

Refer to the **Services** main menu interface to review a summary describing the availability of several central features within the Services main menu item.

NOTE When the switch's configuration is successfully updated (using the Web UI), the effected screen is closed without informing the user their change was successful. However, if an error were to occur, the error displays within the effected screen's Status field. In the case of file transfer operations, the transfer screen remains open during the transfer operation and remains open upon completion (with status displayed within the Status field).

To display a **Services Summary**:

1. Select **Services** from the main menu tree.



2. Refer to the **Services Summary** field for the following information relating to configurable values within the Services main menu item.

DHCP Servers	Displays whether DHCP is enabled and the current configuration. For information on configuring DHCP Server support, see *DHCP Server Settings on page 5-4*.
NTP Time Management	Displays whether time management is currently enabled or disabled. *Network Time Protocol* (NTP) manages time and/or network clock synchronization within the switch managed network. NTP is a client/server implementation.

Redundancy Service	Displays whether Redundancy is currently enabled or disabled. One or more switches can be configured as members of a redundancy group to significantly reduce the chance of a disruption in service to WLANs and associated MUs in the event of failure of a switch or intermediate network failure. For more information, see *Configuring Switch Redundancy on page 5-35*.
Layer 3 Mobility	Displays whether Layer 3 Mobility is currently enabled or disabled. Layer 3 mobility is a mechanism which enables a MU to maintain the same Layer 3 address while roaming throughout a multi-VLAN network. This enables the transparent routing of IP datagrams to MUs during their movement, so data sessions can be initiated while they roam (in for voice applications in particular). Layer 3 mobility enables TCP/UDP sessions to be maintained in spite of roaming among different IP subnets. For more information on configuring Layer 3 Mobility, see *Layer 3 Mobility on page 5-46*.
Self Healing	Displays whether Self Healing is currently enabled. Self healing enables radios to take action when one or more radios fail. To enable the feature, the user must specify radio neighbors that would self heal if a neighbor goes down. The neighbor radios do not have to be of the same type. An 11bg radio can be the neighbor of a 11a radio and either of them can self heal when one fails. For information on configuring self healing, see *Configuring Self Healing on page 5-53*.

5.2 DHCP Server Settings

The DHCP Server Settings screen displays tabs supporting the following configuration activities:

- *Configuring the Switch DHCP Server*
- *Configuring Existing Host Pools*
- *Configuring Excluded IP Address Information*
- *Configuring DHCP Server Relay Information*
- *Viewing DDNS Bindings*
- *Viewing DHCP Bindings*
- *Reviewing DHCP Dynamic Bindings*
- *Configuring DHCP User Class*
- *Configuring DHCP Pool Class*

5.2.1 Configuring the Switch DHCP Server

The switch contains an internal *Dynamic Host Configuration Protocol* (DHCP) Server. DHCP can provide the dynamic assignment of IP addresses automatically. DHCP is a protocol that includes mechanisms for IP address allocation and delivery of host-specific configuration parameters from a DHCP server to a host. Some of these parameters are IP address, network mask and gateway.

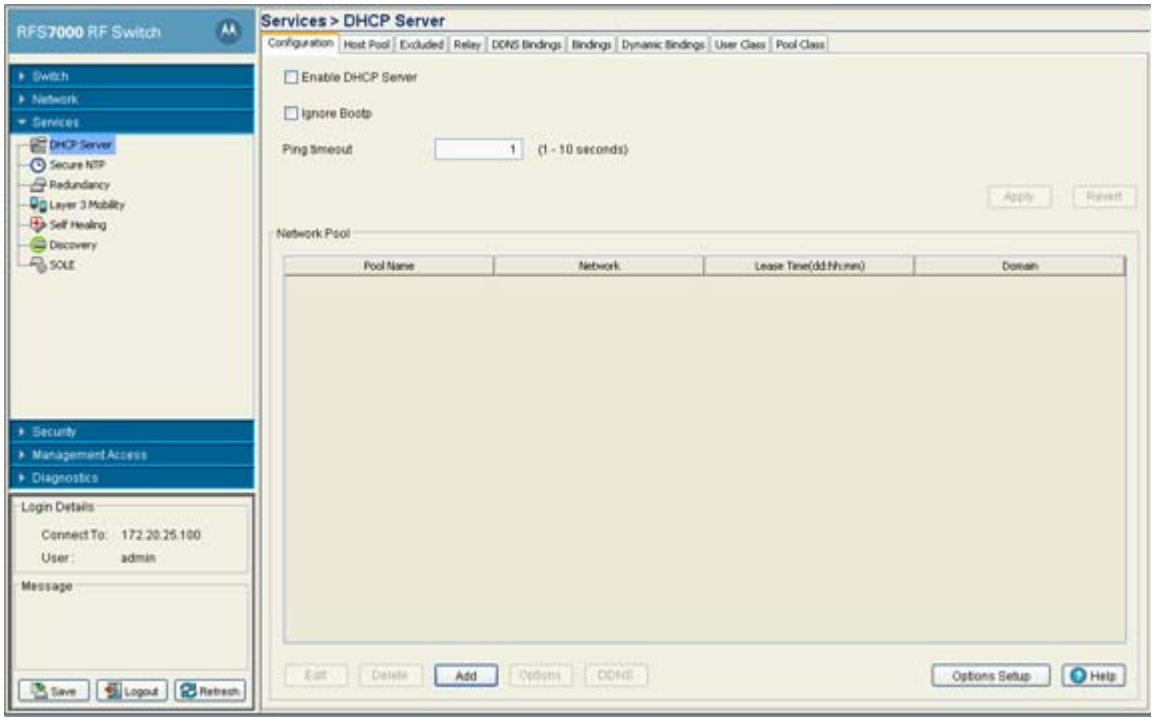
When a DHCP server allocates an address for a client, the client is assigned a lease (which expires after an interval defined by the administrator). Before the lease expires, clients are expected to renew the lease to continue to use the addresses assigned. Once a lease has expired, the client to which that lease was assigned is no longer permitted to use the leased IP address.

NOTE DHCP Server setting updates are only implemented when the service is restarted.

To configure DHCP:

1. Select **Services** > **DHCP Server** from the main menu tree.

The DHCP Server screen displays with the **Configuration** tab displayed.



2. Select the **Enable DHCP Server** checkbox to enable the switch's internal DHCP Server for use with global pools.
3. Select the **Ignore BOOTP** checkbox to bypass a BOOTP request.
4. Define an interval (from 1 -10 seconds) for the ping timeout variable. The switch uses the timeout to intermittently ping and discover whether the client requested IP address is already used.
5. Refer to the following information as displayed within **Network Pool** field.

Pool Name	Displays the name of the IP pool from which IP addresses can be issued to DHCP client requests on the current interface. The pool is the range of IP addresses available.
Network	Displays the network address for the clients.
Lease Time (dd:hh:mm)	When a DHCP server allocates an address for a DHCP client, the client is assigned a lease (which expires after a designated interval defined by the administrator). The lease time is the time an IP address is reserved for re-connection after its last use. Using very short leases, DHCP can dynamically reconfigure networks in which there are more computers than there are available IP addresses. This is useful, for example, in education and customer environments where MU users change frequently. Use longer leases if there are fewer users.
Domain	Displays the domain name for the current interface.

6. Click the **Edit** button to modify the properties displayed on an existing DHCP pool. For more information, see *Editing the Properties of an Existing DHCP Pool on page 5-6*.
7. To delete an existing DHCP pool from the list of those available, highlight the pool from within the Network Pool field and click the **Delete** button.

8. Click the **Add** button to create a new DHCP pool. For more information, see *Adding a New DHCP Pool on page 5-7*.
9. Click the **Options** button to associate values to options, as defined using the Options Setup functionality. The values associated to options are local to the pool with which they are associated. For more information, see *Configuring DHCP Global Options on page 5-9*.
10. Click the **DDNS** button to configure a DDNS domain and server address used with the list of available pools. For more information, see *Configuring DHCP Server DDNS Values on page 5-10*.
11. Click the **Options Setup** button to define the option name, code and type. Associate values to them (by clicking the Options button) only after the options are defined.
12. Click **Apply** to save changes to the screen. Navigating away from the screen without clicking Apply results in all changes to the screen being lost.
13. Click the **Revert** button to display the last saved configuration. Unapplied changes are not saved and must be re-entered.

5.2.1.1 Editing the Properties of an Existing DHCP Pool

The properties of an existing pool can be modified to suit changing network requirements.

To modify the properties of an existing pool:

1. Select **Services** > **DHCP Server** from the main menu tree.
2. Select an existing pool from those displayed (within the Network Pool field) and click the **Edit** button.
3. Modify the name of the IP pool from which IP addresses can be issued to client requests on this interface.
4. Modify the **Domain** name as appropriate for the interface using the pool.
5. Modify the **NetBios Node** used with this particular pool. The NetBios Node could have one of the following types:
   - A **b-broadcast** (broadcast node) broadcasts to query network nodes for the owner of a NetBIOS name.
   - A **p-peer** (peer-to-peer node) uses directed calls to communicate with a known NetBIOS name server, such as a *Windows Internet Name Service* (WINS) server, for the IP address of a NetBIOS machine.
   - A **m-mixed** is a mixed node that uses broadcasted queries to find a node and queries a known p-node name server for the address.
   - A **h-hybrid** is a combination of two or all of the nodes mentioned above.
6. Change the name of the boot file used for this pool within the **Boot File** parameter.
7. From the **Network** field, use the **Associated Interface** drop-down menu to modify (if necessary) the switch interface used for the newly created DHCP configuration. Use VLAN1 as a default interface if no others have been defined.
8. Additionally, define the network **IP Address** and **Subnet Mask** used for DHCP discovery and requests between the DHCP Server and DHCP clients.

NOTE The network IP address and subnet mask of the pool are required to match the addresses of the layer 3 interface for addresses to be supported on that interface.

9. Within the **Lease Time** field, define one of the two kinds of leases the DHCP Server assigns to its clients:

- *Infinite* - If selected, the client can use the assigned address indefinitely.
- *Actual Interval* - Select this checkbox to manually define the interval for clients to use the DHCP server assigned addresses. The default lease time is 1 day, with a minimum setting of 1 minute.

10. Within the **Servers** field, change the server type used with the pool and use the **Insert** and **Remove** buttons to add and remove the IP addresses of the routers used.
11. Modify the **Included Ranges** (starting and ending IP addresses) for this particular pool.

    Use the **Insert** and **Remove** buttons as required to define the range of supported IP addresses.

    A network pool without any include range is as good as not having a pool at all, because it won't be useful in assigning addresses.
12. Click **OK** to save and add the changes to the running configuration and close the dialog.
13. Refer to the **Status** field (at the bottom of the current screen).

    The Status is the current state of the requests made from the applet. Requests are any “SET/GET” operation from the applet. The Status field displays error messages if something goes wrong in the transaction between the applet and the switch.
14. Click **Cancel** to close the dialog without committing updates to the running configuration.

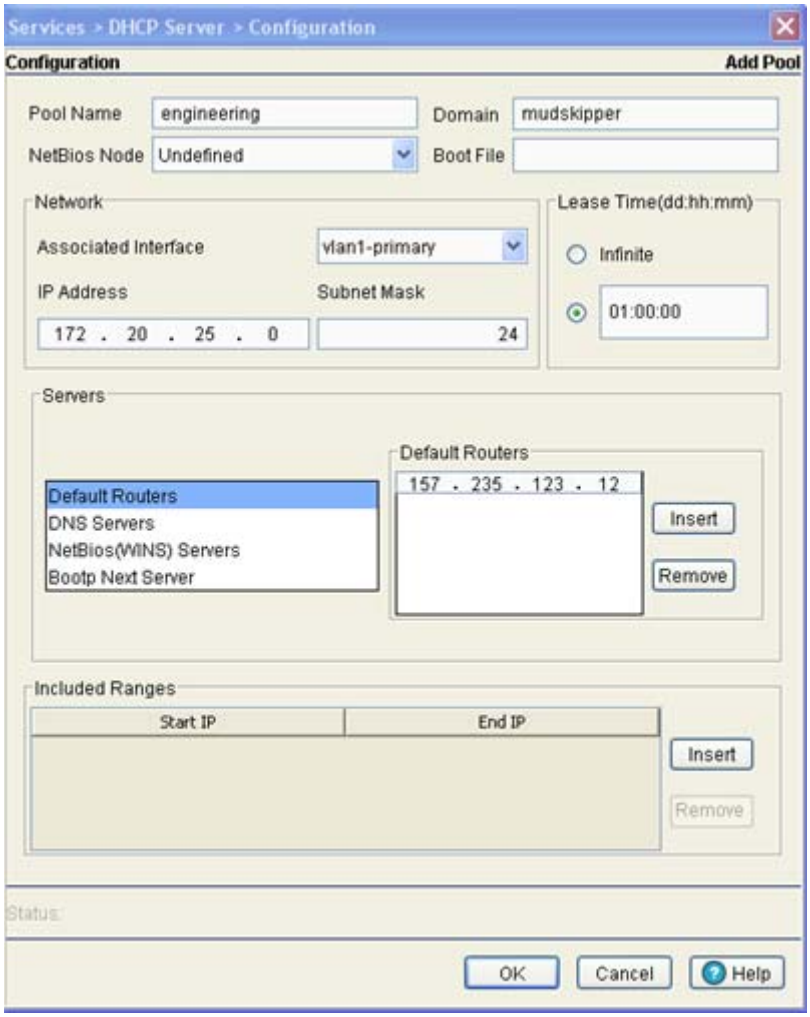
5.2.1.2 Adding a New DHCP Pool

Add a new DHCP pool as needed to suit the address distribution requirements of your network.

To add a DHCP pool:

1. Select **Services** > **DHCP Server** from the main menu tree.

2. Click the **Add** button at the bottom of the screen.



3. Enter the name of the IP pool from which IP addresses can be issued to client requests on this interface.
4. Provide the **Domain** name as appropriate for the interface using the pool.
5. Enter the **NetBios Node** used with this particular pool. The NetBios Node could have one of the following types:
   - A **b-broadcast** (broadcast node) uses broadcasting to query nodes on the network for the owner of a NetBIOS name.
   - A **p-peer** (peer-to-peer node) uses directed calls to communicate with a known NetBIOS name server, such as a *Windows Internet Name Service* (WINS) server, for the IP address of a NetBIOS machine.
   - An **m-mixed** is a mixed node that uses broadcasted queries to find a node, and failing that, queries a known p-node name server for the address.
   - An **h-hybrid** is a combination of two or all of the nodes mentioned above.
6. Enter the name of the boot file used for this pool within the **Boot File** parameter.
7. From the **Network** field, use the **Associated Interface** drop-down menu to define the switch interface is used for the newly created DHCP configuration. Use VLAN1 as a default interface if no others have been defined.

Additionally, define the network **IP Address** and **Subnet Mask** used for DHCP discovery and requests between the DHCP Server and DHCP clients.

NOTE The network IP address and subnet mask of the pool are required to match the addresses of the layer 3 interface in order for the addresses to be supported through that interface.

8. Within the **Lease Time** field, define one of the two kinds of leases the DHCP Server assigns to its clients:
   - *Infinite* - If selected, the client can use the assigned address indefinitely.
   - *Actual Interval* - Select this checkbox to manually define the interval for clients to use DHCP supplied addresses. The default lease time is 1 day, with a minimum setting of 10 seconds and a maximum value of 946080000 seconds.
9. Within the **Servers** field, change the server type used with the pool and use the **Insert** and **Remove** buttons to add and remove the IP addresses of the routers used.
10. Provide the **Included Ranges** (starting and ending IP addresses) for this particular pool.

    Use the **Insert** and **Remove** buttons as required to define the range of supported IP addresses.

    A network pool without any include range is as good as not having a pool, because it won't be useful in assigning addresses.
11. Click **OK** to save and add the changes to the running configuration and close the dialog.
12. Refer to the **Status** field.

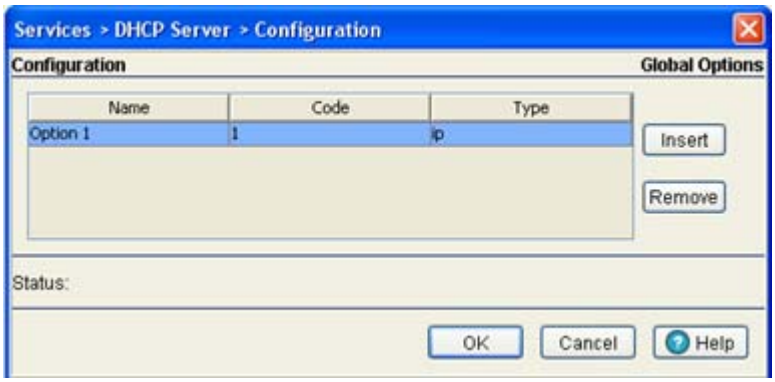
    The Status is the current state of the requests made from the applet. Requests are any "SET/GET" operation from the applet. The Status field displays error messages if something goes wrong in the transaction between the applet and the switch.
13. Click **Cancel** to close the dialog without committing updates to the running configuration

5.2.1.3 Configuring DHCP Global Options

The DHCP Server screen's Configuration tab can be used to display an additional **Global Options** screen.

To define new global name and value and send it to other peer switches in the mobility domain:

1. Select **Services** > **DHCP Server** from the main menu tree.
2. Highlight an existing pool name from within either the Configuration tab and click the **Options Setup** button.



3. Click the **Insert** button to display an editable field wherein the name and value of the DHCP option can be added.

4. **Name** the option as appropriate, assign a **Code** (numerical identifier) and use the **Type** drop-down options to specify a value of ip or ascii to the DHCP global option.
5. Highlight an entry from within the Global Options screen and click the **Remove** button to delete the name and value.
6. Click **OK** to save and add the changes to the running configuration and forward the updates to the other peer switches comprising the mobility domain.
7. Refer to the **Status** field.

   The Status is the current state of the requests made from the applet. Requests are any "SET/GET" operation from the applet. The Status field displays error messages if something goes wrong in the transaction between the applet and the switch.
8. Click **Cancel** to close the dialog without committing updates to the running configuration

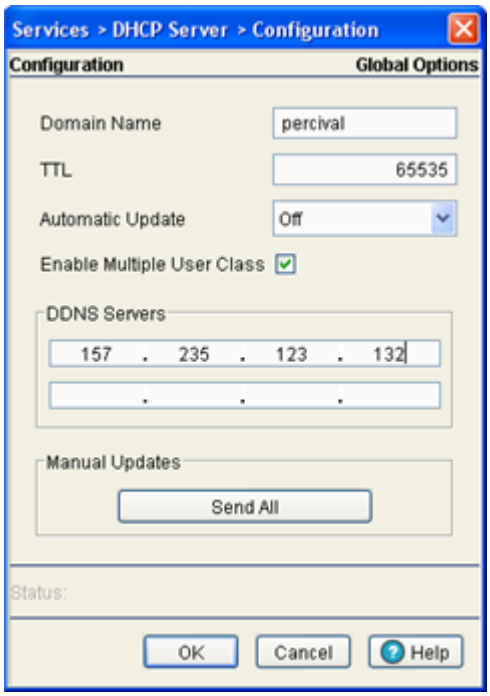
5.2.1.4 Configuring DHCP Server DDNS Values

The DHCP Server screen's Configuration tab can be used to display an additional **DDNS** screen. Use this screen to define a DDNS domain name and address for use with the switch.

To configure a global domain name and DDNS server address:

1. Select **Services** > **DHCP Server** from the main menu tree.

   The DHCP Server screen displays with the **Configuration** tab displayed.
2. Highlight an existing pool name from within the Configuration tab and click the **DDNS** button at the bottom of the screen.



3. Enter a **Domain Name** which represents the forward zone in the DNS server. For example *test.net*.
4. Define the **TTL** (Time to Live) to specify the validity of DDNS records. The maximum value is 65535 seconds.

5. Use the **Automatic Update** drop-down menu to specify whether the automatic update feature is on or off. Select **Server update** to enable a DDNS update from the DHCP server. Select **Client update** to get the DDNS updates from DHCP clients.
6. Select the **Enable Multiple User Class** if multiple user class support is needed.
7. Use the **DDNS Servers** field to define the IP addresses of the DNS servers.
8. Click **OK** to save and add the changes to the running configuration and close the dialog.
9. Refer to the **Status** field.

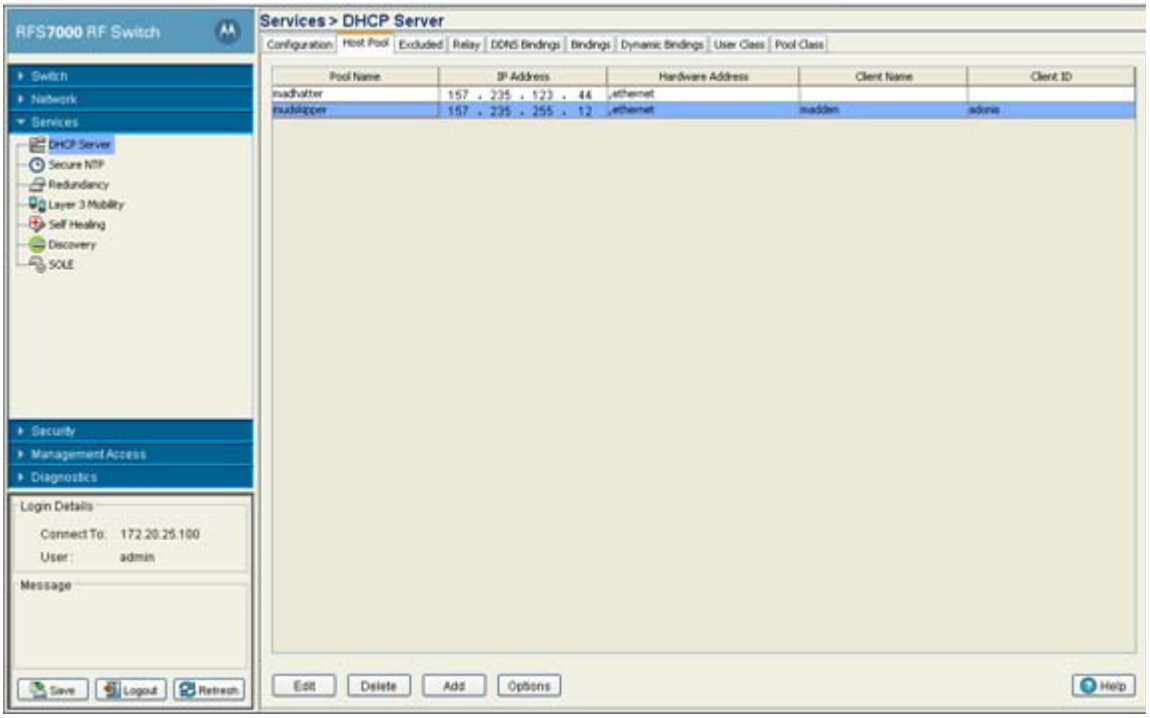
   The Status is the current state of the requests made from the applet. Requests are any "SET/GET" operation from the applet. The Status field displays error messages if something goes wrong in the transaction between the applet and the switch.
10. Click **Cancel** to close the dialog without committing updates to the running configuration

5.2.2 Configuring Existing Host Pools

Refer to the **Host Pool** tab within the DHCP Server screen to view how a host pool reserves IP addresses for specific MAC addresses. This information can be an asset in determining if a new pool needs to be created or an existing pool requires modification.

To view the attributes of existing host pools:

1. Select **Services** > **DHCP Server** from the main menu tree.
2. Select the **Host Pool** tab



3. Refer to the following information to assess whether the existing group of DHCP pools is sufficient:

Pool Name	Displays the name of the IP pool from which IP addresses can be issued to DHCP client requests on this interface. The pool is the range of IP addresses for which addresses can be assigned.

IP Address	Displays the IP address for the client using the pool name listed.
Hardware Address	Displays the type of interface used to pass DHCP discover and request exchanges between the switch DHCP server and DHCP clients. The Hardware Address field also displays the address of the DHCP client for whom the static IP is reserved.
Client Name	Displays the name of the client requesting DHCP Server support over this interface.
Client ID	Displays the client identifier based on the identifier static IP assigned. The hardware address and the client identifier should not be configured on the same host pool.

4. Click the **Edit** button to modify the properties displayed on an existing DHCP pool. For more information, see *Editing the Properties of an Existing DHCP Pool on page 5-6*.
5. To delete an existing DHCP pool from the list of those available, highlight the pool from within the Pool Name field and click the **Delete** button.
6. Click the **Add** button to create a new DHCP pool. For more information, see *Adding a New DHCP Pool on page 5-7*.
7. Click the **Options** button to insert a global pool name into the list of available pools. For more information, see *Configuring DHCP Global Options on page 5-9*.

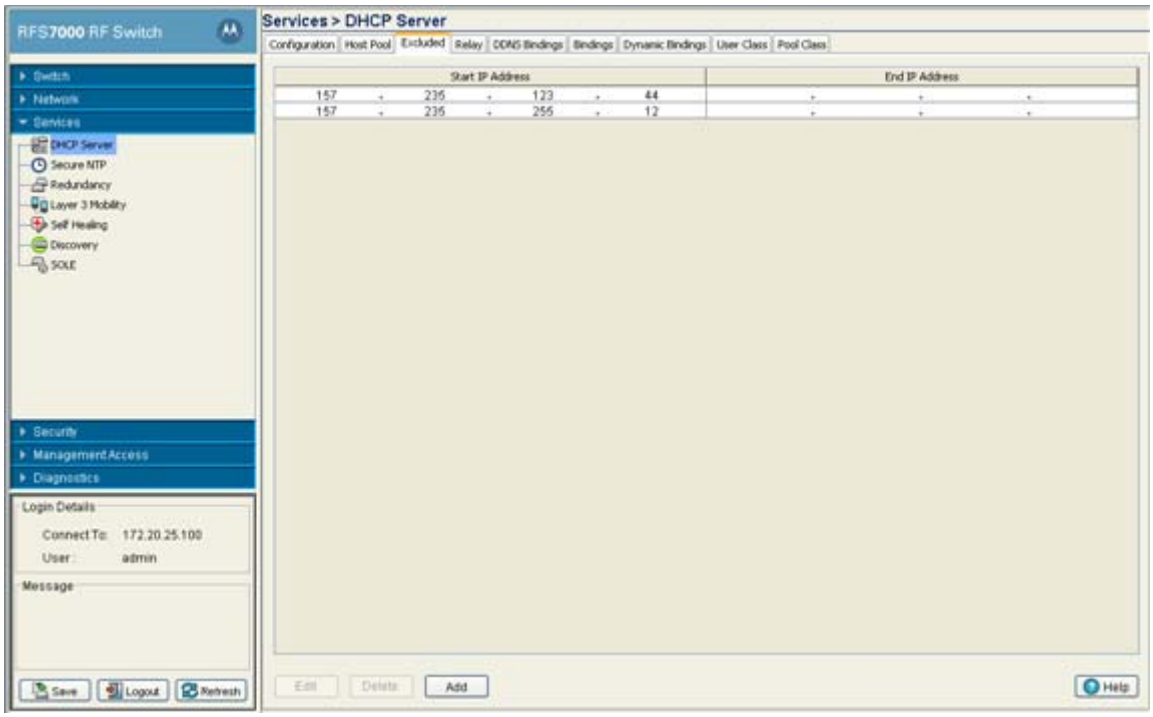
5.2.3 Configuring Excluded IP Address Information

The DHCP Server may have some IP addresses unavailable when assigning IP address ranges for a pool. If IP addresses have been manually assigned and fixed, they need to be made available for the administrator to exclude from possible selection.

To view excluded IP address ranges:

1. Select **Services** > **DHCP Server** from the main menu tree.

2. Click the **Excluded** tab.



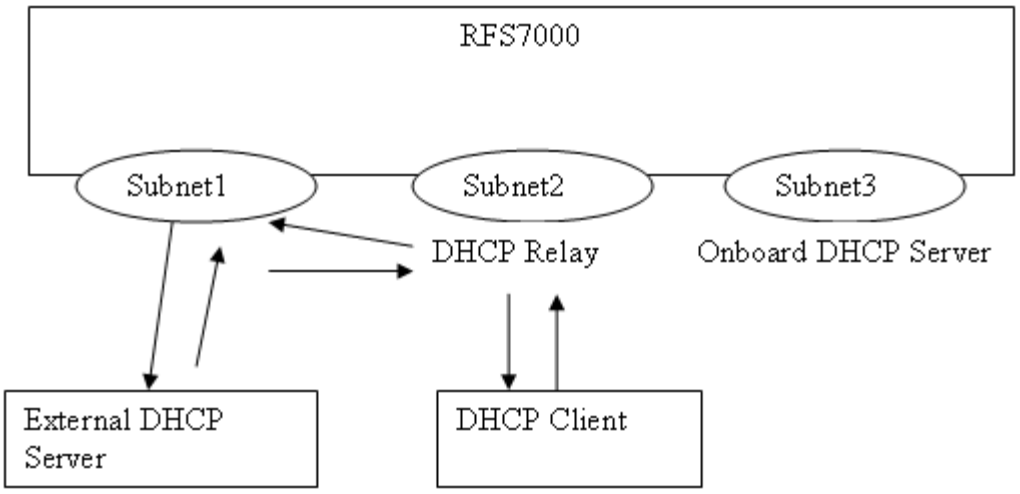
The Excluded tab displays "fixed" IP addresses statically assigned and unavailable for assignment with a pool.

3. Click the **Edit** button to modify the IP address range displayed. For more information, see *Editing the Properties of an Existing DHCP Pool on page 5-6*.
4. To delete an existing DHCP pool from the list of those available to the switch, highlight the pool from within the Network Pool field and click the **Delete** button.
5. Click the **Add** button to create a new IP address range for a target host pool. For more information, see *Adding a New DHCP Pool on page 5-7*.

5.2.4 Configuring DHCP Server Relay Information

Refer to the **Relay** tab to view the current DHCP Relay configurations for available switch VLAN interfaces. The Relay tab also displays the VLAN interfaces for which the DHCP Relay is enabled/configured. The Gateway Interface address information is helpful in selecting the interface suiting the data routing requirements between the External DHCP Server and DHCP client (present on one of the switch's available VLANs).

NOTE DHCP Server and relay can run on different switch VLAN interfaces.

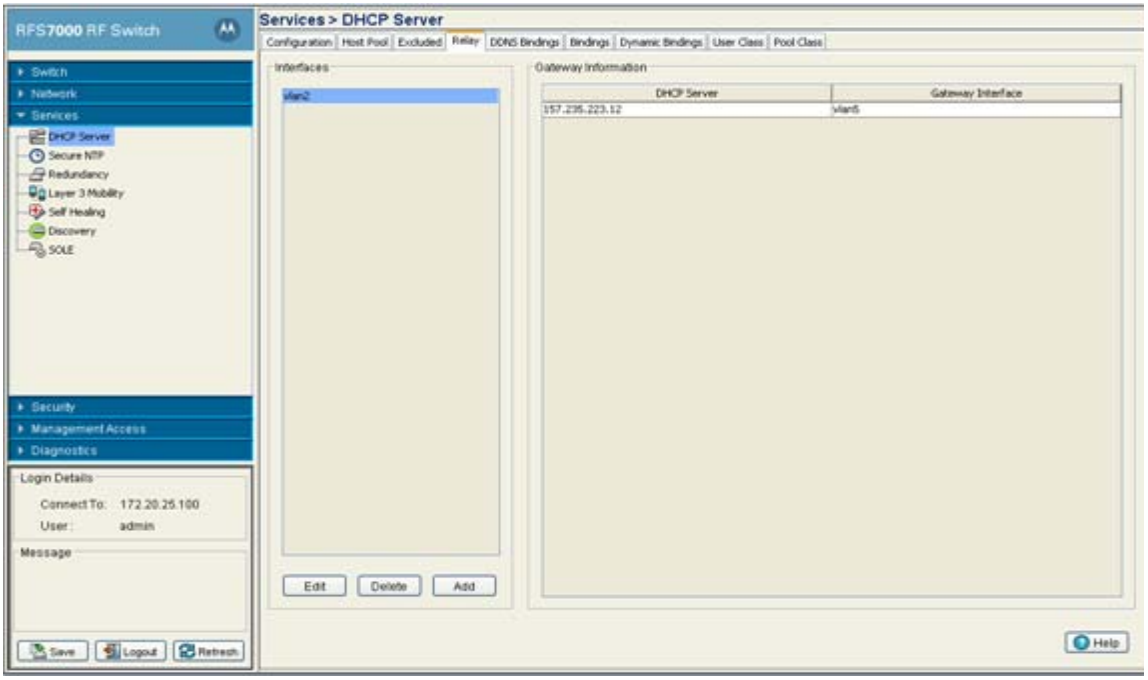


In the illustration above, a DHCP relay address has been configured on subnet 2 (The CLI equivalent is "ip helper-address <subnet1 External DHCP Server IP > <subnet1 Interface Name>"). When configuring a DHCP Relay address, specify the other interface where the external DHCP Server can be reached. In this example, that interface is subnet1. The DHCP relay agent must listen on both subnet1 and subnet2. Consequently, the DHCP Server cannot run on either subnet1 or subnet2 (it must be both).

However, you can run an onboard DHCP server on subnet3 to provide DHCP requests for clients in subnet3. This is independent of the DHCP relay configuration. You cannot run onboard DHCP Server on subnet1 to provide IP addresses to DHCP clients requesting IP addresses using DHCP relay.

To view DHCP relay information:

1. Select **Services** > **DHCP Server** from the main menu tree.
2. Click the **Relay** tab.



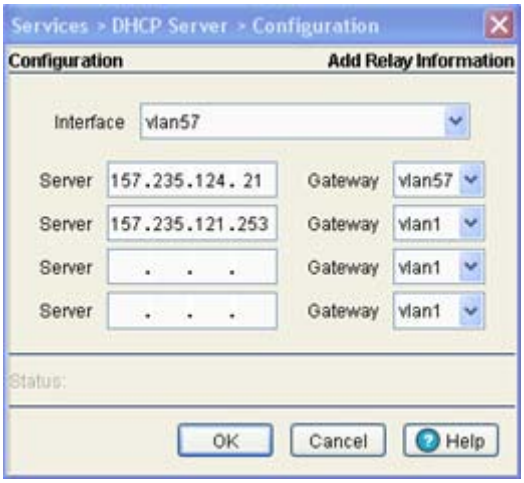
3. Refer to the **Interfaces** field for the names of the interfaces available to route information between the DHCP Server and DHCP clients. If this information is insufficient, consider creating a new IP pool or edit an existing pool.
4. Refer to the **Gateway Information** field for DHCP Server and Gateway Interface IP addresses. Ensure these address are not in conflict with the addresses used to route data between the DHCP Server and client.

NOTE The gateway address should not be set to a VLAN interface used by the switch.

5. Click the **Edit** button to modify the properties displayed for an existing DHCP relay configuration. Refer to step 7 for editable properties for the DHCP relay.
6. To delete a relay interface, highlight it from those available and click the **Delete** button.

NOTE The interface VLAN and gateway interface should have their IP addresses set. The interface VLAN and gateway interface should not have DHCP client or DHCP Server enabled. DHCP packets cannot be relayed to an onboard DHCP Server. The interface VLAN and gateway interface cannot be the same.

7. Click the **Add** button to create a new DHCP relay for a specific switch VLAN interface.
   a. Use the **Interface** drop-down menu to assign the interface for the DHCP relay. As VLANs are added to the switch, the number of available interfaces grows.
   b. Add **Servers** as needed based on the availability of external DHCP servers. As Servers are added, use the **Gateway** drop-down menu (associated with each Server) to supply the interface on which this external DHCP server can be reached.
   c. Click **OK** to save and add the changes to the running configuration and close the dialog.
   d. Click **Cancel** to close the dialog without committing updates to the running configuration.



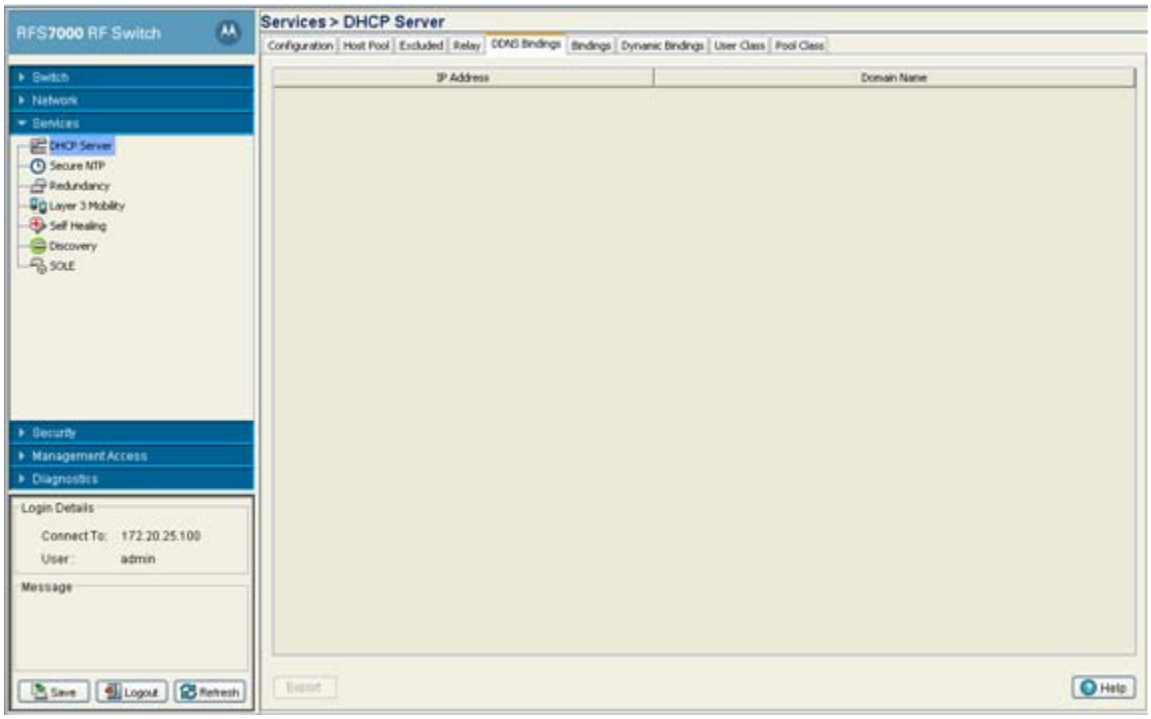
5.2.5 Viewing DDNS Bindings

The **DDNS Bindings** tab displays mappings between client IP addresses and domain names. DDNS keeps a domain name linked to a changing IP address. Typically, when a user connects to a network, the user's ISP assigns an unused IP address from a pool of IP addresses (usually done through a DHCP server). This address is only valid for a limited time. The mechanism of dynamically assigning IP addresses increases the pool of

assignable IP addresses. DNS is a service, which maintains a database to map a given name to an IP address used for communication on the Internet. The dynamic assignment of IP addresses makes it necessary to update the DNS database to reflect the current IP address for a given name.

To view detailed DDNS Binding information:

1. Select **Services** > **DHCP Server** from the main menu tree.
2. Select the **DDNS Bindings** tab.



3. Refer to the contents of the DDNS Bindings tab:

IP Address	Displays the IP address assigned to the client.
Domain Name	Displays the domain name mapping corresponding to the IP address listed in the left-hand side of the tab.

4. Click the **Export** button to display a screen used to export DDNS Binding information to a secure location.

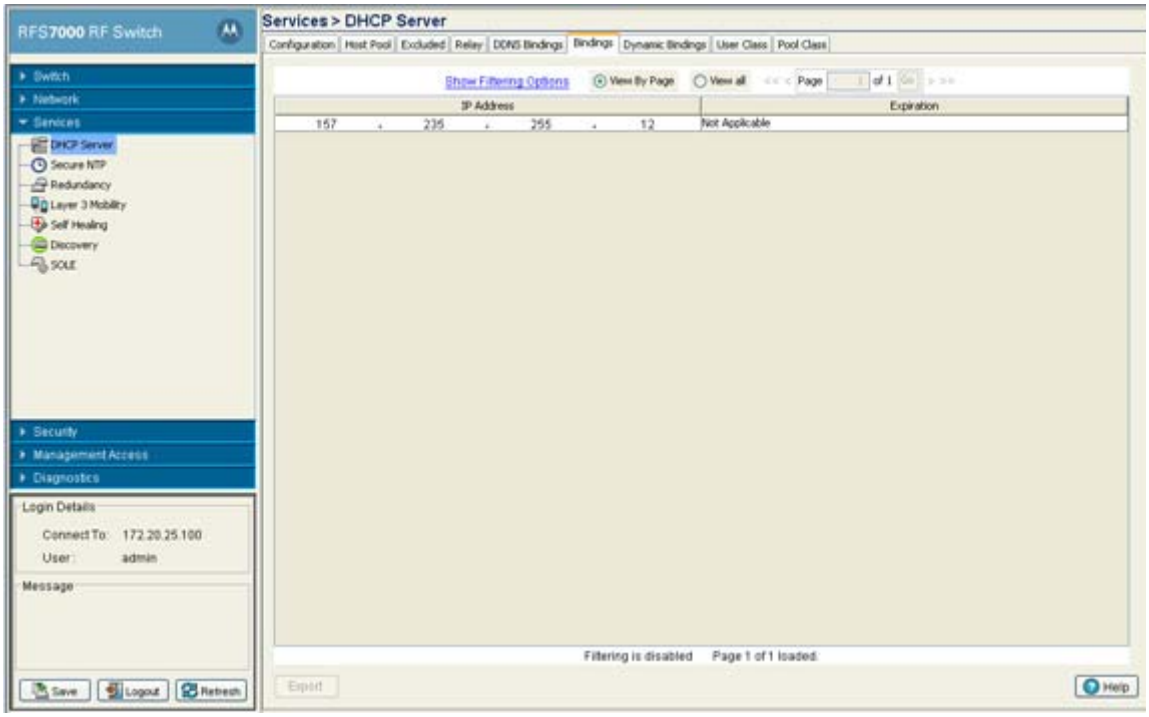
5.2.6 Viewing DHCP Bindings

The Bindings tab displays addresses and expiration times. There are two types of bindings, manual and automatic. Manual bindings map a hardware address to a IP address statically. Automatic bindings dynamically map a hardware address to an IP address from a pool of available addresses.

To view detailed binding information:

1. Select **Services** > **DHCP Server** from the main menu tree.

2. Click the **Bindings** tab.



3. Refer to the contents of the **Bindings** tab for the following:

IP Address	Displays a IP address for each client with a listed MAC address. This column is read-only and cannot be modified.
Expiration	Displays the end point for the address listed in the IP Address column.

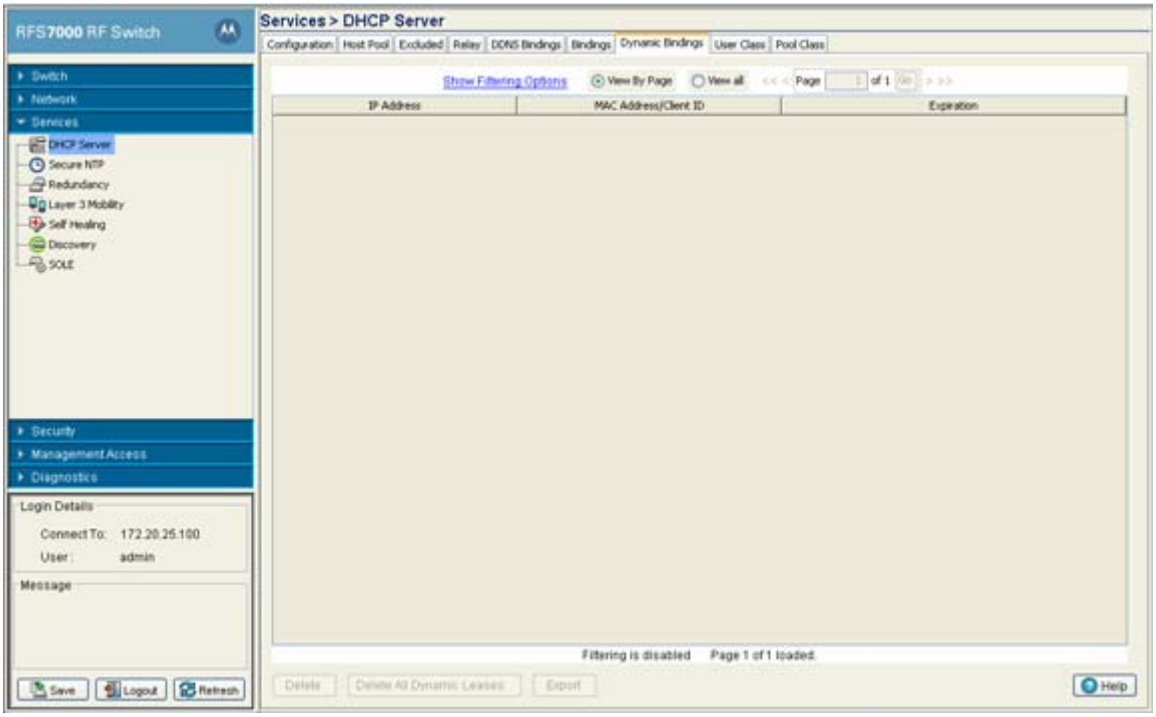
4. Click the **Export** button to display a screen used to export the DHCP Binding information to a secure location.

5.2.7 Reviewing DHCP Dynamic Bindings

Dynamic DHCP bindings automatically map a hardware address to an IP address from a pool of available addresses. The Dynamic Bindings tab displays only automatic bindings.

To view detailed Dynamic Binding information:

1. Select **Services** > **DHCP Server** from the main menu tree.
2. Select the **Dynamic Bindings** tab.



3. Refer to the contents of the Dynamic Bindings tab for the following:

IP Address	Displays the IP address for each client whose MAC Address is listed in the MAC Address / Client ID column. This column is read-only and cannot be modified.
MAC Address / Client ID	Displays the MAC address (client hardware ID) of the client using the switch's DHCP Server to access switch resources. The MAC address is read-only and cannot be modified.
Expiration	Displays the expiration of the lease used by the client for switch DHCP resources. This column is read-only and cannot be modified.

4. Select an address from those displayed and click the **Delete** button to remove the client from the list displayed. The Delete button is enabled only when one or more rows are selected for deletion.
5. Click on **Delete All Automatic Leases** button to delete all the automatic leased DHCP connections. This button is enabled when one or more rows exist.
6. Click the **Export** button to display a screen used to export the DHCP Binding information to a secure location.

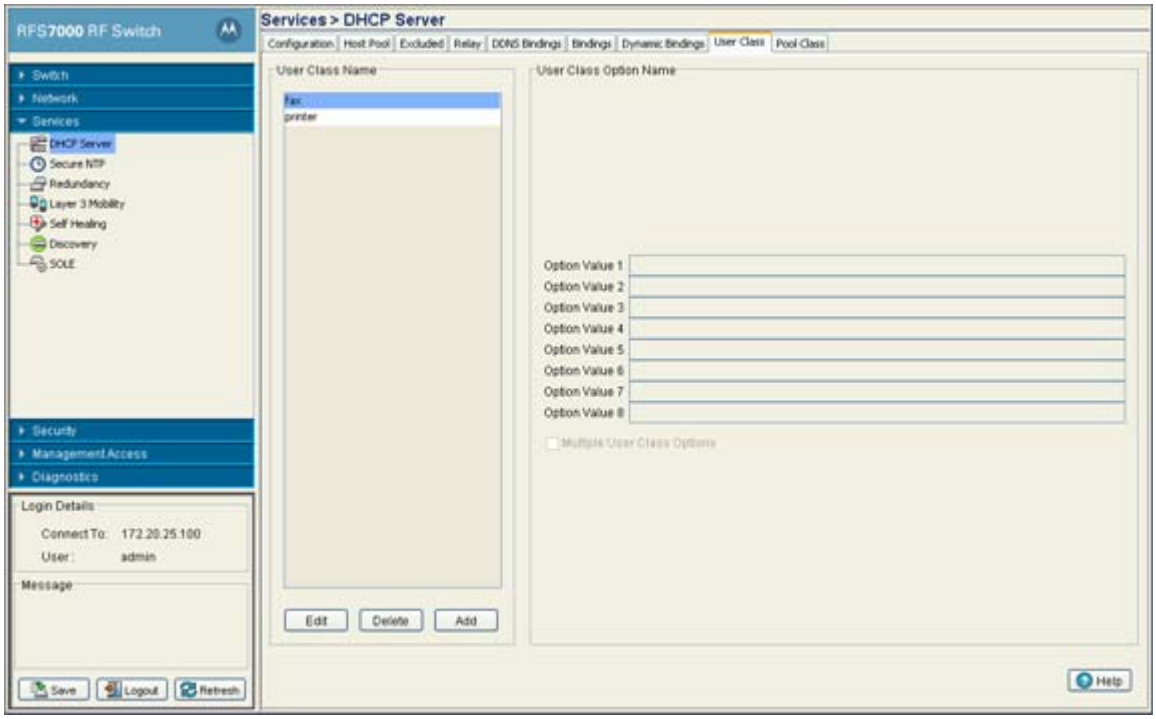
5.2.8 Configuring DHCP User Class

The DHCP server assigns IP addresses to clients based on user class option names. Clients with a defined set of user class options are identified by user class name.

The DHCP server assigns IP addresses from multiple IP address ranges. The DHCP user class associates a particular range of IP addresses to a device in such a way that all devices of that type are assigned IP addresses from the defined range.

To view the attributes of existing host pools:

1. Select **Services** > **DHCP Server** from the main menu tree.
2. Select the **DHCP User Class** tab to view the DHCP user class and its associated user class option names.



3. The **DHCP User Class Name** field displays the client names grouped by class.
4. The **DHCP User Class Option Name** field displays the names defined for a particular client.

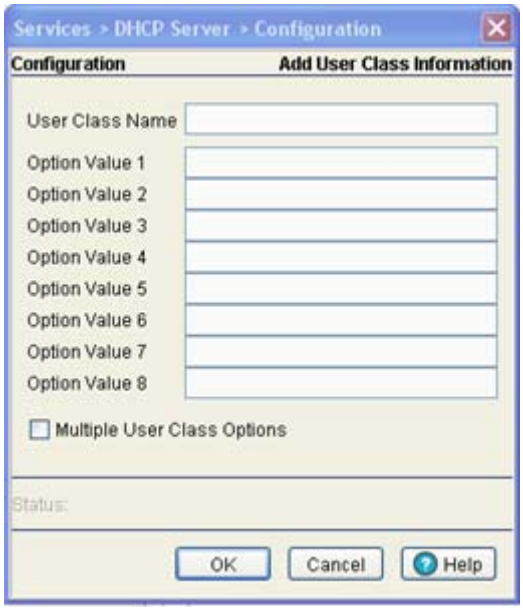
   Select the **Multiple User Class Options** checkbox to associate a user class option with a multiple user class.
5. Click the **Add** button create a new user class name (client). For more information, see *Adding a New DHCP User Class Name on page 5-20*.
6. Click the **Edit** button to modify the properties displayed for an existing DHCP User Class Name. For more information, see *Editing the Properties of an Existing DHCP User Class Name on page 5-20*.
7. To delete an existing DHCP user class and its associated option names from the list available to the DHCP server, select the user class from the **User Class Name** field and click **Delete**.

5.2.8.1 Adding a New DHCP User Class Name

A DHCP user class name can be configured with a maximum of 8 user class option values.

To view and configure the user class options associated with the particular class:

1. Select **Services** > **DHCP Server** from the main menu tree.
2. Select the **User Class** tab.
3. Click the **Add** button from the **User Class Name** field.



The DHCP server groups clients based on user class option values. DHCP Clients with the defined set of user class option values are identified by class.

a. Enter the **User Class Name** to create a new client. The DHCP user class name should not exceed 32 characters.

b. Enter **Option Values** for the devices associated with the DHCP user class name. The value should not exceed 32characters.

c. Select the **Multiple User Class Option** checkbox to enable multiple option values for the user class. This allows the user class to transmit multiple option values to DHCP servers supporting multiple user class options.

d. Click **OK** to save and add the new configuration.

e. Refer to the **Status** field. It displays the current state of the requests made from the applet. Requests are any "SET/GET" operation from the applet. The Status field displays error messages if something goes wrong in the transaction between the applet and the switch.

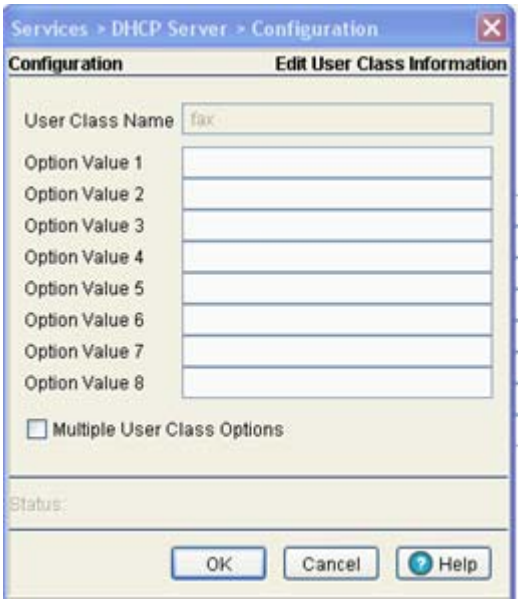
f. Click **Cancel** to close the dialog without committing updates to the running configuration.

5.2.8.2 Editing the Properties of an Existing DHCP User Class Name

The properties of an existing DHCP user class can be modified to suit the changing needs of your network. To modify the properties of an existing DHCP user class:

1. Select **Services** > **DHCP Server** from the main menu tree.
2. Select the **User Class** tab.

3. Select an existing DHCP user class from the list and click the **Edit** button from the **User Class Name** field.



   a. The **User Class Name** cannot be modified.

   b. Either add or modify the **Option Values** as required to suit the changing needs of your network. The option values should not exceed 32 characters.

   c. Select the **Multiple User Class Option** checkbox to enable multiple option values for the user class. This allows the user class to transmit multiple option values to DHCP servers which support multiple user class options.

   d. Click **OK** to save and add the new configuration.

   e. Refer to the **Status** field. It displays the current state of the requests made from the applet. Requests are any "SET/GET" operation from the applet. The Status field displays error messages if something goes wrong in the transaction between the applet and the switch.

   f. Click **Cancel** to close the dialog without committing updates to the running configuration.

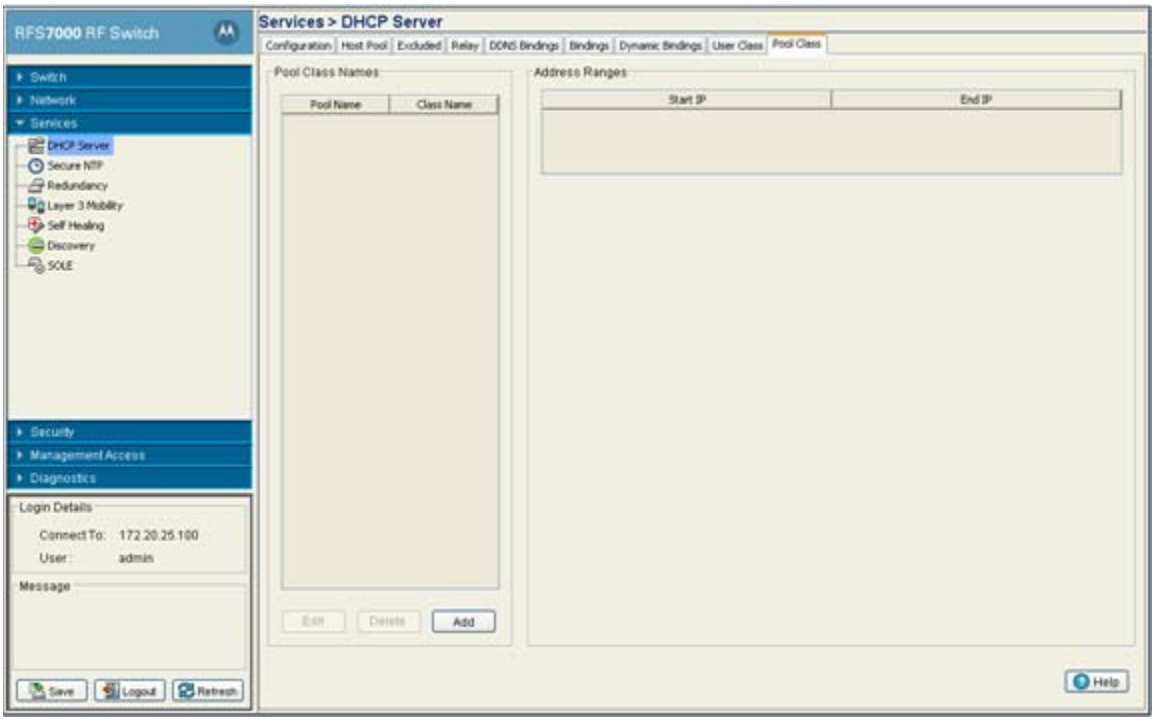
5.2.9 Configuring DHCP Pool Class

The DHCP server can associate multiple classes to each pool. Each class in a pool is assigned an exclusive range of IP addresses.

DHCP clients are matched against classes. If the client matches one of the classes assigned to the pool, it's assigned the IP address from the range assigned to the class. If the client does not match any of the classes in the pool, it's assigned the IP address from the pool's default range (if configured).

To view the attributes of existing host pools:

1. Select **Services** > **DHCP Server** from the main menu tree.
2. Select the **Pool Class** tab to view the DHCP pool class details.



3. Refer to the **Pool Class Names** field to configure a pool class.

   The **Address Ranges** field displays the address ranges associated with the pool class.
4. Click the **Edit** button to modify the properties displayed for an existing Pool Class Name. For more information, see *Editing an Existing DHCP Pool Class Name on page 5-23*
5. To delete an existing DHCP pool class name and its associated address range, select the pool class name from the **Pool Class Names** field and click the **Delete** button.
6. Click the **Add** button create a new pool class name. For more information, see *Adding a New DHCP Pool Class Name on page 5-23*.

5.2.9.1 Editing an Existing DHCP Pool Class Name

The **Edit Pool Class Configuration** dialog is used to edit the association of a DHCP pool name to a DHCP class name. It is also used to configure a maximum of 4 pool class address range. To revise an existing DHCP pool class name:

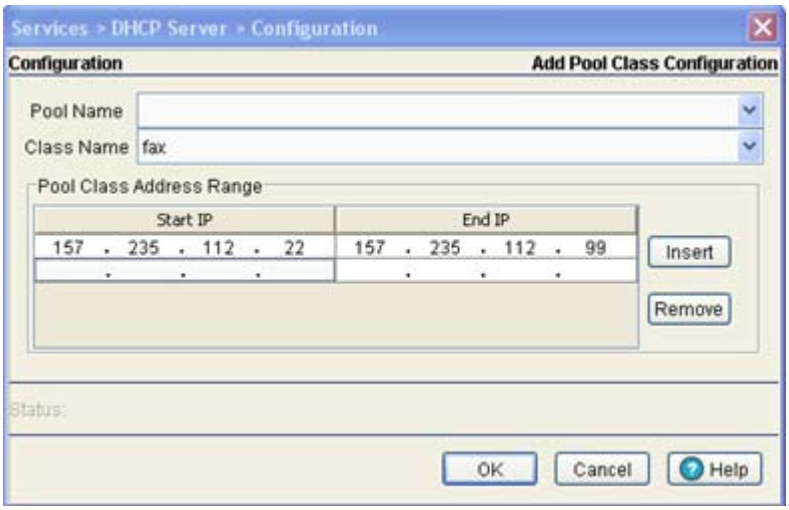
1. Select **Services** > **DHCP Server** from the main menu tree.
2. Select the **Pool Class** tab.
3. Click the **Edit** button from the Pool Class Names field.
4. Refer to the read-only **Pool Name** to ensure modifications are made to the correct pool name.
5. Use the **Class Name** value to associate an existing class, created using *Adding a New DHCP User Class Name on page 5-20*.
6. Refer to the **Pool Class Address Range** field to revise an address range. A maximum of 4 address ranges can be assigned to a class.
   a. Use the **Insert** button to revise the Start IP and End IP address range for a class.
   b. Select a address range and click **Remove** to delete that particular address range.
7. Refer to the **Status** field. It displays the current state of the requests made from the applet. Requests are any "SET/GET" operation from the applet. The Status field displays error messages if something goes wrong in the transaction between the applet and the switch.
8. Click **OK** to save the new configuration and close the dialog window.
9. Click **Cancel** to close the dialog without committing updates to the running configuration.

5.2.9.2 Adding a New DHCP Pool Class Name

The **Add Pool Class Configuration** dialog is used to associate an existing class, created using *Adding a New DHCP Pool Class Name*, to an existing pool, created using *Adding a New DHCP Pool*. It is also used to configure a maximum of 4 pool class address range.

To add a new DHCP pool class:

1. Select **Services > DHCP Server** from the main menu tree.
2. Select the **DHCP Pool Class** tab.
3. Click on the **Add** button from the **Pool Class Names** field.



4. Use the **Pool Name** field to define a new pool name. Enter the pool name created using *Adding a New DHCP Pool on page 5-7*.
5. Use the **Class Name** field to associate an existing class, created using *Adding a New DHCP User Class Name on page 5-20*.
6. The **Pool Class Address Range** field is used to assign address range to the class inside the pool. A maximum of 4 address ranges can be assigned to a class.
   a. Use the **Insert** button to enter the Start IP and End IP address range for a class.
   b. Select a address range and click **Remove** to delete that particular address range.
7. Refer to the **Status** field. It displays the current state of the requests made from the applet. Requests are any "SET/GET" operation from the applet. The Status field displays error messages if something goes wrong in the transaction between the applet and the switch.
8. Click **OK** to save the new configuration and close the dialog window.
9. Click **Cancel** to close the dialog without committing updates to the running configuration

5.3 Configuring Secure NTP

Secure Network Time Protocol (SNTP) is central for networks that rely on their switch to supply system time. Without an SNTP implementation, switch time is unpredictable, which can result in data loss, failed processes and compromised security. With network speed, memory and capability increasing at an exponential rate, the accuracy, precision and synchronization of network time is essential in a switch managed enterprise network. The switch can either use a dedicated server to supply system time or can use several forms of SNTP messaging to sync system time with network traffic authenticated and secure for switch interoperation.

NOTE Often, the switch NTP status will not be adequately updated after modifying the NTP configuration. Periodically check the switch NTP status when making changes to ensure the proper time is displayed, as it may take awhile for the switch to update the proper NTP status.

The SNTP configuration activity is divided amongst the following tasks:

- *Defining the Secure NTP Configuration*
- *Configuring Symmetric Keys*
- *Defining a NTP Neighbor Configuration*
- *Viewing NTP Associations*
- *Viewing NTP Status*

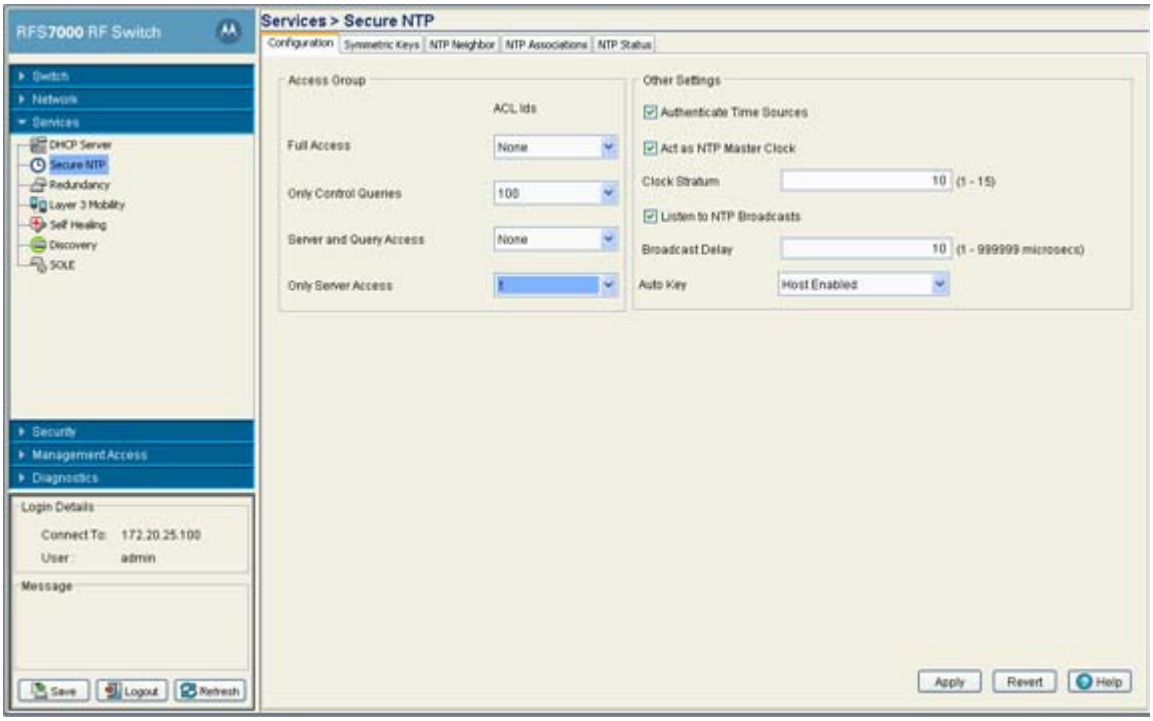
5.3.1 Defining the Secure NTP Configuration

SNTP provides synchronized timekeeping between the switch and a time server. Use the Configuration tab to define how SNTP resources are authenticated before interacting with the switch and enable ACL IDs to be mapped to SNTP access groups.

To define the SNTP configuration:

1. Select **Services** > **Secure NTP** from the main menu tree.

2. Select the **Configuration** tab.



3. Refer to the **Access Group** field to define ACL IDs. An ACL ID must be created before it is selectable from a drop-down menu. To create an ACL ID, see *ACL Configuration on page 6-19*.

Full Access	Supply a numeric ACL ID from the drop-down menu to provide the ACL full access.
Only Control Queries	Supply a numeric ACL ID from the drop-down menu to provide the ACL only control query access to SNTP resources.
Server and Query Access	Enter a numeric ACL ID from the drop-down menu to provide the ACL Server and Query access to SNTP resources.
Only Server Access	Provide a numeric ACL ID from the drop-down menu to provide the ACL only server access to SNTP resources.

4. Refer to the **Other Settings** field to define the following:

Authenticate Time Sources	Select this checkbox to ensure credential authentication takes place between the SNTP server and the switch. When this checkbox is selected, the Apply and Revert buttons become enabled to save or cancel settings.
Act As NTP Master Clock	When this checkbox is selected, the Apply and Revert buttons become enabled to save or cancel settings within the Other Settings field.

Clock Stratum	Define how many hops (from 1 to 15) the switch is from a SNTP time source. The switch automatically chooses the SNTP resource with the lowest stratum number. The SNTP supported switch is careful to avoid synchronizing to a server that may not be accurate. Thus, the SNTP enabled switch never synchronizes to a machine not synchronized itself. The SNTP enabled switch compares the time reported by several sources, and does not synchronize to a time source whose time is significantly different than others, even if its stratum is lower.
Listen to NTP Broadcasts	Select this checkbox to allow the switch to listen over the network for SNTP broadcast traffic. Once enabled, the switch and the SNTP broadcast server must be on the same network.
Broadcast Delay	Enter the estimated round-trip delay (between 1 and 999999 seconds) for SNTP broadcasts between the SNTP broadcast server and the switch. Define the interval based on the priority of receiving accurate system time frequently. Typically, no more than one packet per minute is necessary to synchronize the switch to within a millisecond of the SNTP broadcast server.
Auto Key	Use the Auto Key drop-down menu to specify whether the key is disabled, enabled only on the host or enabled only on the client.

5. Click **Apply** to save changes to the screen. Navigating away from the screen without clicking the Apply button results in all the changes to the screen being discarded.
6. Click the **Revert** button to undo the changes to the screen and revert to the last saved configuration.

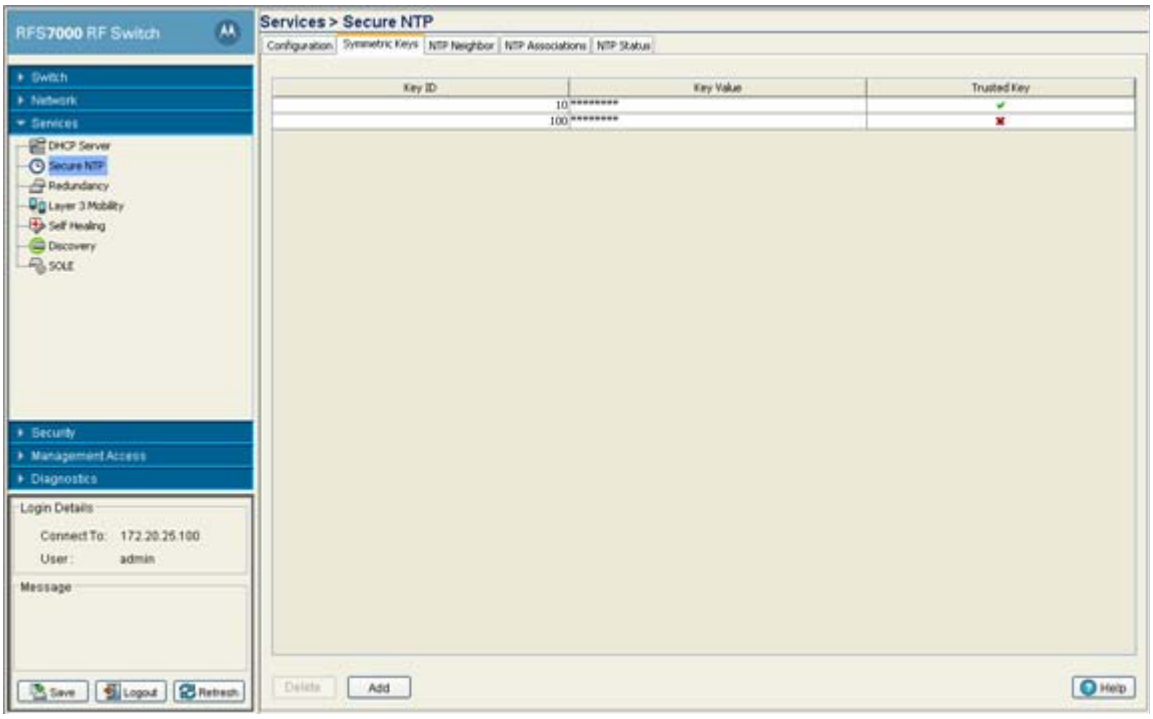
5.3.2 Configuring Symmetric Keys

Symmetric keys are algorithms for cryptography that use trivially related cryptographic keys for both decryption and encryption. The encryption key is related to the decryption key, as they may be identical or there is a simple mechanism to go between keys. The keys represent a shared secret between the switch and its time resource.

To review existing Symmetric Key configurations, and (if necessary) add a new one:

1. Select **Services** > **Secure NTP** from the main menu tree.

2. Select the **Symmetric Keys** tab.



3. Refer to the **Symmetric Key** screen to view the following information.

Key ID	Displays a Key ID between 1-65534. The Key ID is a abbreviation allowing the switch to reference multiple passwords. This makes password migration easier and more secure between the switch and its NTP resource.
Key Value	Displays the authentication value used to secure the credentials of the server providing system time to the switch.
Trusted Key	If a checkmark appears, a trusted key has been associated with a domain name. A trusted key is added when a public key is known, but cannot be securely obtained. Adding the trusted key allows information from the server to be considered secure. The authentication procedures requires both the local and remote servers share the same key and key identifier. Therefore, using key information from a trusted source is important.

4. Select an existing Key and click the **Delete** button to permanently remove it from the list of Key IDs.
5. Click the **Add** button to create a new Symmetric Key that can be used by the switch. For more information on adding a new key, see *Adding a New SNTP Symmetric Key on page 5-27*.

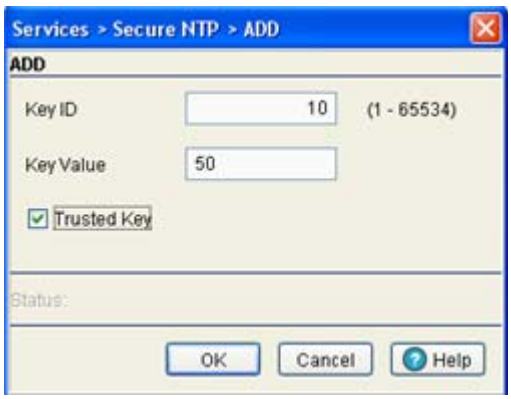
CAUTION After an NTP synchronization using a Symmetric Key, the NTP status will not automatically be updated.

5.3.2.1 Adding a New SNTP Symmetric Key

To add a new key:

1. Select **Services** > **Secure NTP** from the main menu tree.

2. Select the **Symmetric Key** tab.
3. Click the **Add** button.



4. Enter a Key ID between 1-65534. The **Key ID** is a abbreviation allowing the switch to reference multiple passwords. This makes password migration easier and more secure between the switch and its NTP resource.
5. Enter the authentication **Key Value** used to secure the credentials of the NTP server providing system time to the switch.
6. Select the **Trusted Key** checkbox to use a trusted key. A trusted key should be used when a public key is known, but cannot be securely obtained. Adding a trusted key allows data to be considered secure between the switch and its SNTP resource.
7. Refer to the **Status** field.

   The Status is the current state of the requests made from the applet. Requests are any "SET/GET" operation from the applet. The Status field displays error messages if something goes wrong in the transaction between the applet and the switch.
8. Click **OK** to save and add the changes to the running configuration and close the dialog.
9. Click **Cancel** to close the dialog without committing updates to the running configuration.

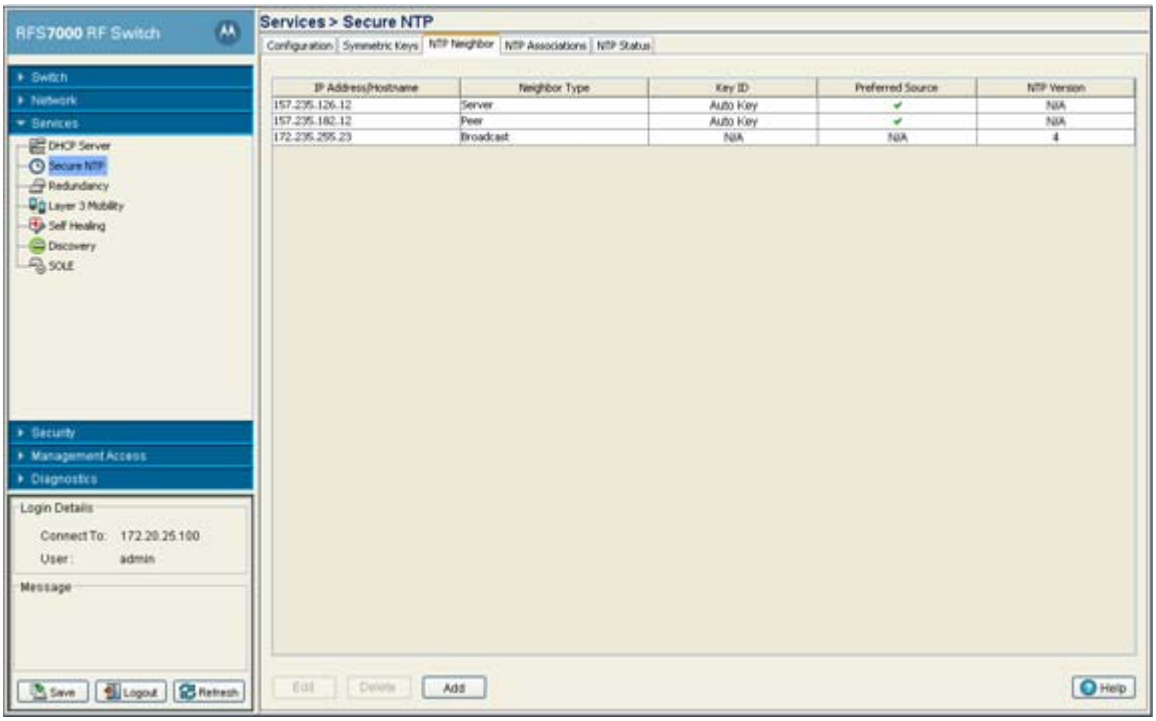
5.3.3 Defining a NTP Neighbor Configuration

The switch's SNTP association can be either a neighboring peer (the switch synchronizes to another associated device) or a neighboring server (the switch synchronizes to a dedicated SNTP server resource). Refer to the **NTP Neighbor** tab to assess the switch's existing configurations (both peer and server) and, if necessary, modify the attributes of an existing peer or server configuration or create a new neighbor peer or server SNTP configuration.

To review the switch's existing NTP neighbor configurations:

1. Select **Services** > **Secure NTP** from the main menu tree.

2. Select the **NTP Neighbor** tab.



3. Refer to the following information (as displayed within the NTP Neighbor tab) to assess whether an existing neighbor configuration can be used as is, if an existing configuration requires modification or a new configuration is required.

IP Address/Hostname	Displays the numeric IP address of the resource (peer or server) providing switch SNTP resources. Ensure the server is on the same subnet as the switch to provide SNTP support.
Neighbor Type	Displays whether the NTP resource is a Peer (another associated peer device capable of SNTP support) or a Server (a dedicated SNTP server resource). This designation is made when adding or editing an NTP neighbor.
Key ID	Displays whether AutoKey Authentication or Symmetric Key Authentication is used to secure the interaction between the switch and its NTP resource. This designation is made when adding or editing an NTP neighbor.
Preferred Source	Displays whether this NTP resource is a preferred NTP resource. Preferred sources (those with a checkmark) are contacted before non-preferred resources. There can be more than one preferred source.
NTP Version	Displays a NTP version between 1 and 4. Currently version three and four implementations of NTP are available. The latest version is NTPv4, but the official Internet standard is NTPv3.

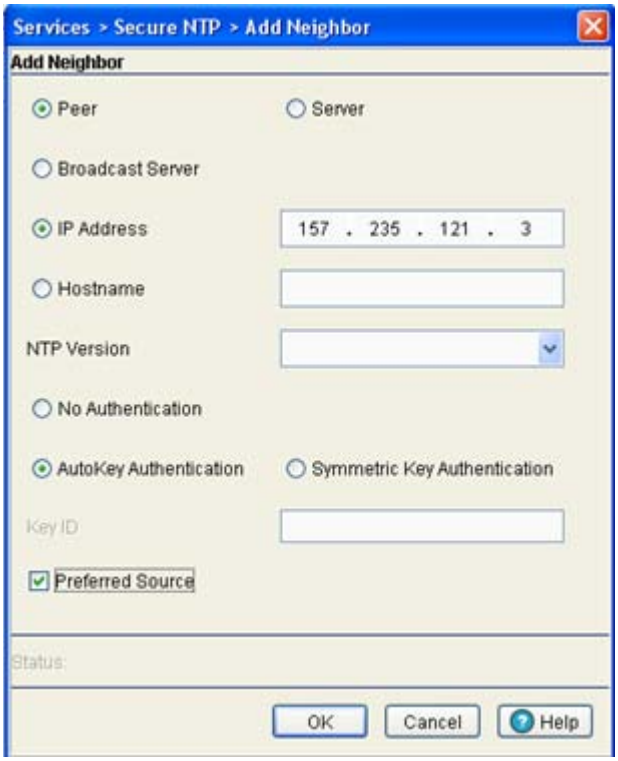
4. Select an existing neighbor and click the **Edit** button to modify the existing peer or server designation, IP address, version, authentication key ID and preferred source designation.
5. Select an existing entry and click the **Delete** button to remove it from the table.

6. Click the **Add** button to define a new peer or server configuration that can be added to the existing configurations displayed within the NTP Neighbor tab.For more information, see *Adding an NTP Neighbor on page 5-30*.

5.3.4 Adding an NTP Neighbor

To add a new NTP peer or server neighbor configuration to those available for synchronization:

1. Select **Services** > **Secure NTP** from the main menu tree.
2. Select the **NTP Neighbor** tab.
3. Click the **Add** button.



4. Select the **Peer** checkbox if the SNTP neighbor is a peer to the switch (non FTP server) within the switch's current subnet.
5. Select the **Server** checkbox if the neighbor is a server within the switch's current subnet.
6. Select the **Broadcast Server** checkbox to allow the switch to listen over the network for NTP broadcast traffic.

   The switch's NTP configuration can be defined to use broadcast messages instead of messaging between fixed NTP synchronization resource addresses. Use a NTP broadcast to listen for NTP synchronization packets within a network. To listen to NTP broadcast traffic, the broadcast server

(and switch) must be on the same subnet. NTP broadcasts reduce configuration complexity since both the switch and its NTP resources can be configured to send and receive broadcast messages.

NOTE If this checkbox is selected, the AutoKey Authentication checkbox is disabled, and the switch is required to use Symmetric Key Authentication for credential verification with its NTP resource. Additionally, if this option is selected, the broadcast server cannot be selected as a preferred source.

7. Enter the **IP Address** of the peer or server providing SNTP synchronization.
8. Select the **Hostname** checkbox to assign a hostname to the server or peer for further differentiation of other devices with a similar configuration.
9. Use the **NTP Version** drop-down menu to select the version of SNTP to use with this configuration Currently version three and version four implementations of NTP are available. The latest version is NTPv4, but the official Internet standard is NTPv3.
10. If necessary, select the **No Authentication** checkbox to allow communications with the NTP resource without any form of security. This option should only be used with known NTP resources.
11. Select the **AutoKey Authentication** checkbox to use an Auto key protocol based on the *public key infrastructure* (PKI) algorithm. The SNTP server uses a fast algorithm and a private value to regenerate key information on the arrival of a message. The switch sends its designated public key to the server for credential verification and the two exchange messages. This option is disabled when the Broadcast Server checkbox is selected.
12. Select the **Symmetric Key Authentication** checkbox to use a single (symmetric) key for encryption and decryption. Since both the sender and the receiver must know the same key, it is also referred to as shared key cryptography. The key can only be known by the sender and receiver to maintain secure transmissions.
13. Enter an **Key ID** between 1-65534. The Key ID is a Key abbreviation allowing the switch to reference multiple passwords.
14. Select the **Preferred Source** checkbox if this NTP resource is a preferred NTP resource. Preferred sources are contacted before non-preferred resources. There can be more than one preferred source.
15. Refer to the **Status** field. The Status is the current state of the requests made from the applet. Requests are any "SET/GET" operation from the applet. The Status field displays error messages if something goes wrong in the transaction between the applet and the switch.
16. Click **OK** to save and add the changes to the running configuration and close the dialog.
17. Click **Cancel** to close the dialog without committing updates to the running configuration.

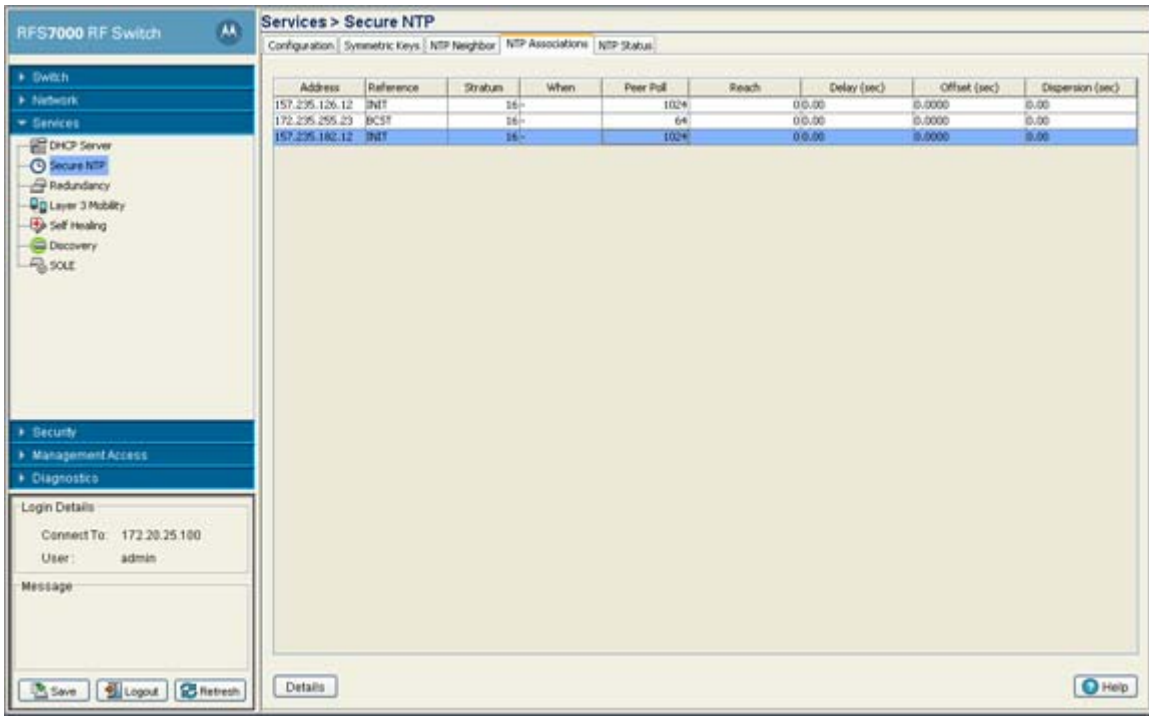
5.3.5 Viewing NTP Associations

The interaction between the switch and a SNTP server constitutes an association. SNTP associations can be either a peer association (the switch synchronizes to the another system or allows another system to synchronize to it), or a server association (only the switch synchronizes to the SNTP resource, not the other way around).

To review the switch's current SNTP associations:

1. Select **Services** > **Secure NTP** from the main menu tree.

2. Select the **NTP Associations** tab.

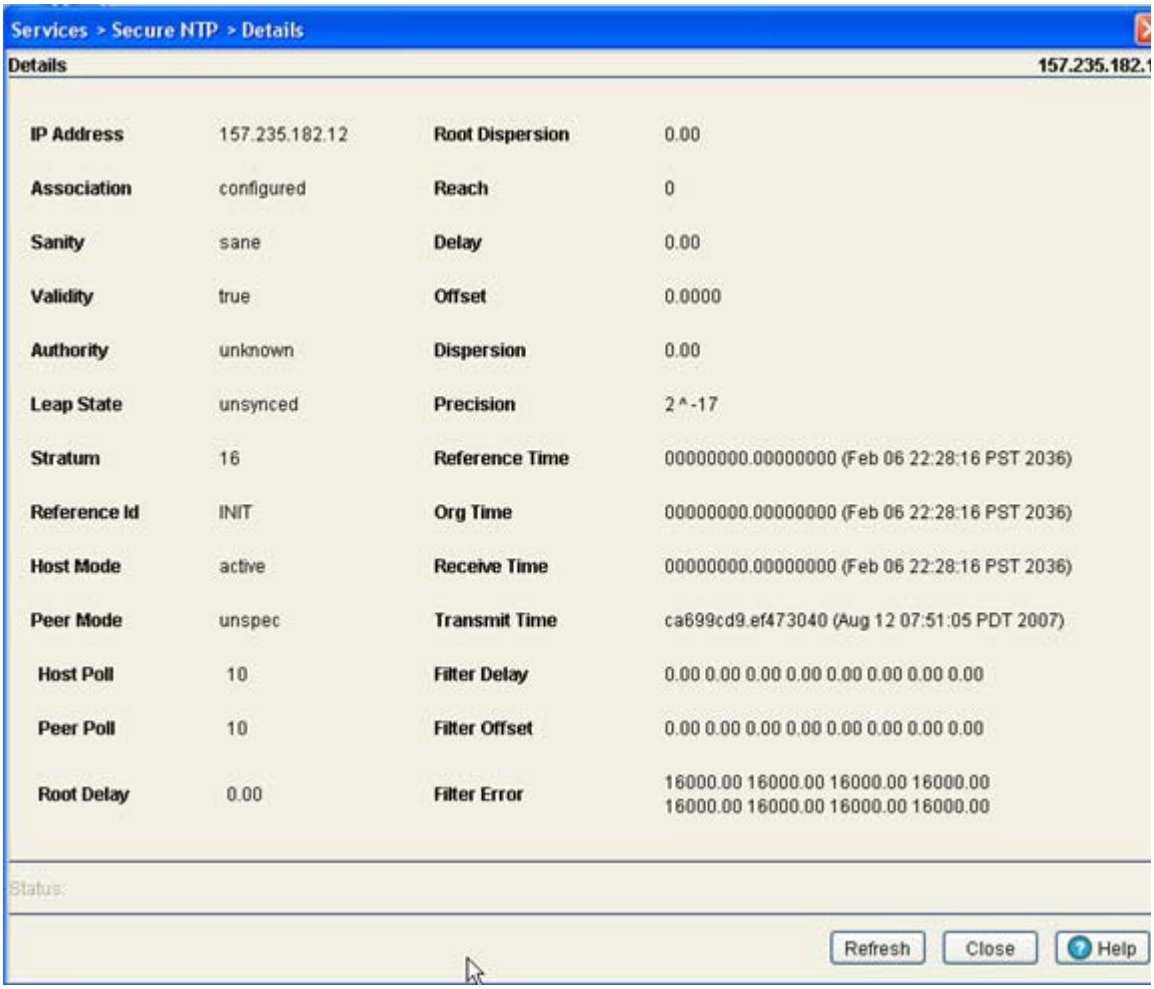


3. Refer to the following SNTP Association data for each SNTP association displayed:

Address	Displays the numeric IP address of the SNTP resource (Server) providing SNTP updates to the switch.
Reference Clock	Displays the address of the time source the switch is synchronized with.
Stratum	Displays how many hops the switch is from a SNTP time source. The switch automatically chooses the SNTP resource with the lowest stratum. The SNTP supported switch is careful to avoid synchronizing to a server that may not be accurate. Thus, the NTP enabled switch never synchronizes to a machine not synchronized itself. The SNTP enabled switch compares the time reported by several sources, and does not synchronize to a time source whose time is significantly different than others, even if its stratum is lower.
When	Displays the date and time when the SNTP association was initiated. Has the association been trouble free over that time?
Peer Poll	Displays the maximum interval between successive messages, in seconds to the nearest power of two.
Reach	Displays the status of the last eight SNTP messages. If an SNTP packet is lost, the lost packet is tracked over the next eight SNTP messages.
Delay (sec)	Displays the round-trip delay (in seconds) for SNTP broadcasts between the SNTP server and the switch.

Offset (sec)	Displays the calculated offset between the switch and SNTP server. The switch adjusts its clock to match the server's time value. The offset gravitates toward zero over time, but never completely reduces its offset to zero.
Dispersion (sec)	Displays how scattered the time offsets are (in seconds) from a SNTP time server

4. Select an existing NTP association and click the **Details** button to display additional information useful in discerning whether the association should be maintained.



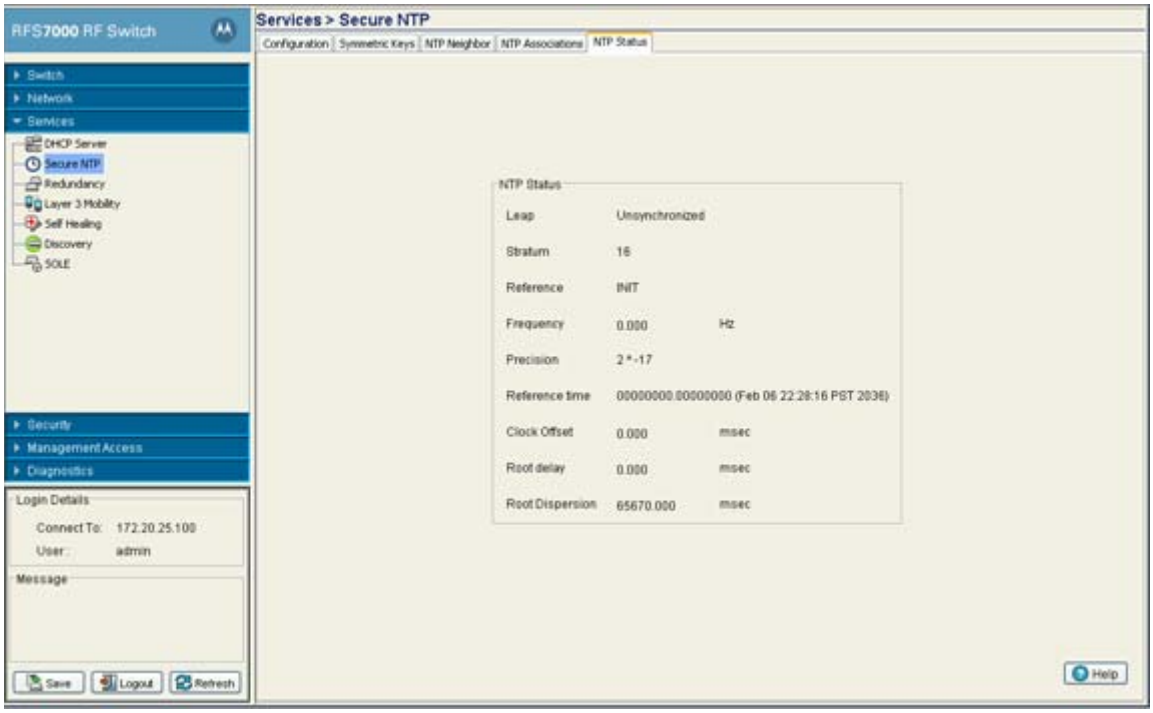
5.3.6 Viewing NTP Status

Refer to the **NTP Status** tab to display performance (status) information relative to the switch's current NTP association. Verifying the switch's SNTP status is important to assess which resource the switch is currently getting its system time from, as well as the time server's current differences in time attributes as compared to the current switch time.

CAUTION After an NTP synchronization using a Symmetric Key, the NTP status will not automatically update.

To review the switch's current NTP associations:

1. Select **Services** > **Secure NTP** from the main menu tree.
2. Select the **NTP Status** tab.



3. Refer to the **SNTP Status** field to review the accuracy and performance of the switch's ability to synchronize with a NTP server:

Leap	Indicates if a second will be added or subtracted to SNTP packet transmissions, or if the transmissions are synchronized.
Stratum	Displays how many hops the switch is from its current NTP time source.
Reference	Displays the address of the time source the switch is synchronized to.
Frequency	A SNTP server clock's skew (difference) for the switch

Precision	Displays the precision (accuracy) of the switch's time clock (in Hz). The values that normally appear in this field range from -6 for mains-frequency clocks to -20 for microsecond clocks found in some workstations.
Reference time	Displays the time stamp at which the local clock was last set or corrected.
Clock Offset	Displays the time differential between switch time and the NTP resource.
Root delay	The total round-trip delay in seconds. This variable can take on both positive and negative values, depending on the relative time and frequency offsets. The values that normally appear in this field range from negative values of a few milliseconds to positive values of several hundred milliseconds.
Root Dispersion	Displays the nominal error relative to the primary time source in seconds. The values that normally appear in this field range from 0 to several hundred milliseconds.

5.4 Configuring Switch Redundancy

Configuration and network monitoring are two tasks a network administrator faces as a network grows in terms of the number of managed nodes (switches, routers, wireless devices etc.). Such scalability requirements lead network administrators to look for managing and monitoring each node from a single centralized management entity. The RFS7000 not only provides a centralized management solution, it provides centralized management from any single switch in the network without restricting or dedicating one switch as a centralized management node. This eliminates dedicating a management entity to manage all redundancy members and eliminates the possibility of a single point of failure.

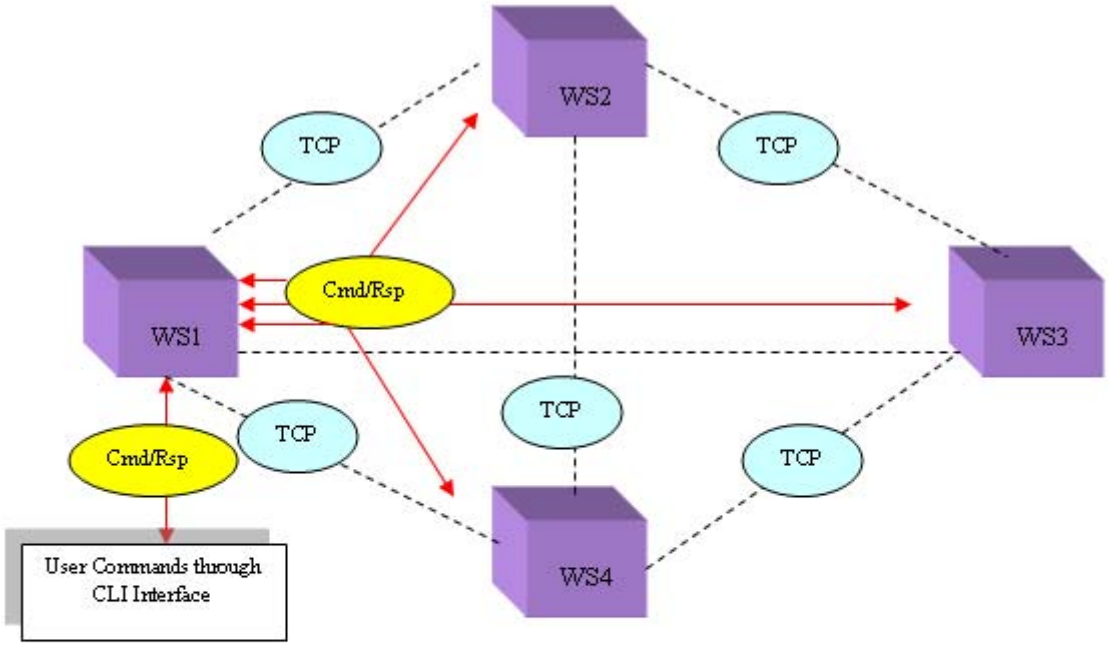
A redundancy group (cluster) is a set of switches (nodes) uniquely identified by group/cluster ID. Within the redundancy group, members discover and establish connections to other group members. The redundancy group has full mesh connectivity using TCP as the transport layer connection.

Up to 12 switches can be configured as members of a redundancy group to significantly reduce the chance of a disruption in service to WLANs and associated MUs in the event of failure of a switch or intermediate network failure. All members can be configured using a common file (cluster-config) using DHCP options. This functionality provides an alternative method for configuring members collectively from a centralized location, instead of configuring specific redundancy parameters on individual switches.

Configure each switch in the cluster by logging in to one participating switch. The administrator does not need to login to each redundancy group member, as one predicating switch can configure each member in real-time without "pushing" configurations between switches. A new CLI context called "cluster-cli" is available to set the configuration for all members of the cluster. All switch CLI commands are considered cluster configurable.

In the example below, there are four switches (WS1, WS2, WS3 and WS4) forming a redundancy group. Each switch has established a TCP connection with the others in the group. There is an additional CLI context called cluster-context. A user/administrator can get into this context by executing a "cluster-cli enable" under the CLI interface (future releases will have this support in the Web UI and SNMP interfaces). When the user executes this command on WS1, WS1 creates a virtual session with the other switches in the redundancy group (WS2, WS3 and WS4). Once the virtual session is created, any command executed on WS1 is executed on the other

switches at the same time. This is done by the cluster-protocol running on WS1, by duplicating the commands and sending them to the group over the virtual connection.



Legends:

TCP -- TCP connection

Cmd/Rsp -- Unicast Command and Response flow

After sending the command to other members, the cluster-management protocol (at WS1) waits for a response from the members of the redundancy group. Upon receiving a response from each member, WS1 updates the user's screen and allows the user to enter/execute the next command.

The wait time required to collect responses from other switches is predefined, so if any one or more members does not respond to a given command within the defined interval, the command originating switch displays whatever responses have been collected and ignores the delayed responses. This time-based response mechanism eliminates the possibility of indefinite response hangs and allows for quicker redundancy group configuration.

There is no fixed master-slave relationship between members. Typically, a switch can be considered a master for the command it originates. Responding members can be considered slaves with respect to that command.

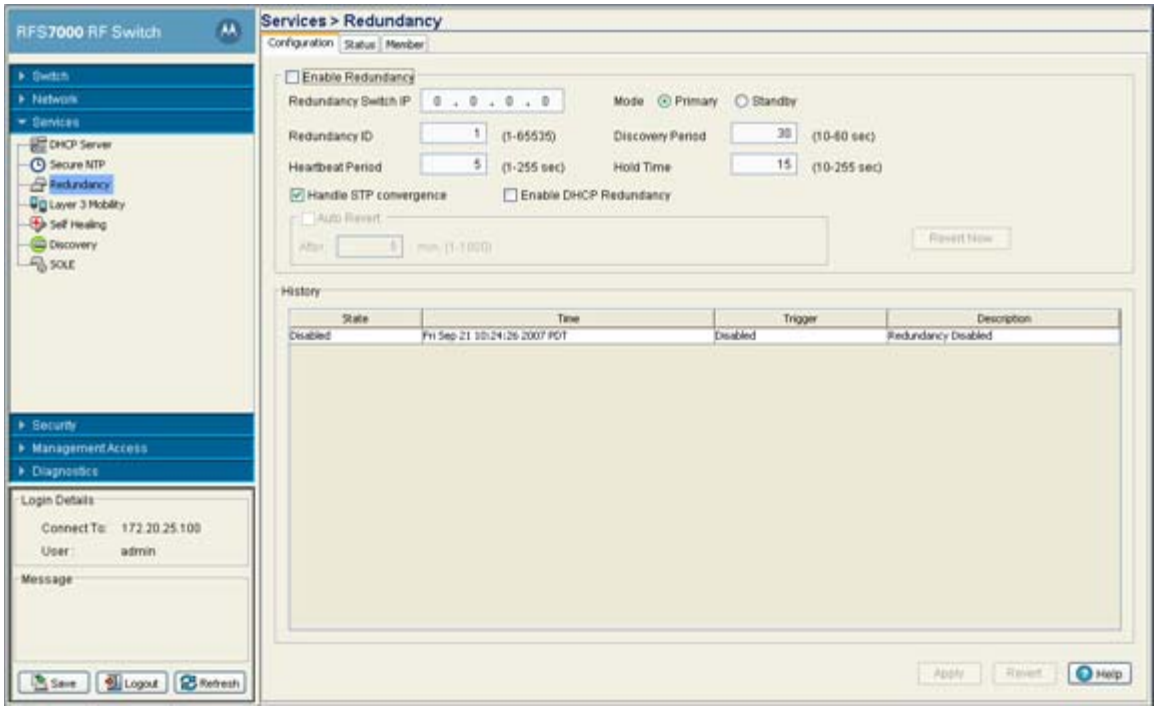
This virtual master-slave relationship makes this design unique when compared to existing centralized management systems. Having a virtual master-slave relationship eliminates a single point of failure, since a user can make use of any switch as the group centralized management entity (using the cluster-management context).

To view status and membership data and define a redundancy group configuration, refer to the following:

- *Reviewing Redundancy Status*
- *Configuring Redundancy Group Membership*

To configure switch redundancy:

1. Select **Services** > **Redundancy** from the main menu tree.
   The Redundancy screen displays with the Configuration tab selected.



2. Refer to the **Redundancy** field to define the following:

Enable Redundancy	Select this checkbox to enable/disable clustering. Clustering must be disabled to set a redundancy related parameter. All the modifiable values are grayed out if enabled
Redundancy Switch IP	Define the destination IP address used to send heartbeats and update messages.
Mode	A member can be in either in **Primary** or **Standby** mode. In the redundancy group, all 'Active' members adopt access ports except the 'Standby' members who adopt access ports only when an 'Active' member has failed or sees an access-port not adopted by a switch.
Redundancy ID	Define an ID for the cluster group. All the switches configured in the cluster should have the same Cluster ID. The valid range is 1-65535.
Discovery Period	Use the **Discovery Period** to configure a cluster member discovery interval. During the discovery time, a switch discovers the existence of other switches within the redundancy group. Configure an interval between 10 and 60 seconds. The default value is 30 seconds.

Heartbeat Period	The **Heartbeat Period** is the interval heartbeat messages are sent. Heartbeat messages discover the existence and status of other members within the group. Configure an interval between 1 and 255 seconds. The default value is 5seconds.
Hold Time	Define the **Hold Time** for a redundancy group. If there are no heartbeats received from a peer during the hold time, the peer is considered down. In general, the hold period is configured for three times the heartbeat period. Meaning, if three consecutive heartbeats are not received from the peer, the peer is assumed down and unreachable. The hold time is required to be longer than the heartbeat interval. Configure a hold time between 10 and 255 seconds. The default is 15 seconds.
Handle STP convergence	Select the **Handle STP convergence** checkbox to enable *Spanning Tree Protocol* (STP) convergence for the switch. In general, this protocol is enabled in layer 2 networks to prevent network looping. If the network is enabled for STP to prevent looping, the network forwards data only after STP convergence. Enabling STP convergence delays the redundancy state machine execution until the STP convergence is completed (the standard protocol value for STP convergence is 50 seconds). Delaying the state machine is important to load balance access ports at startup.
Enable DHCP Redundancy	Enables DHCP Redundancy for member switches. DHCP Redundancy allows an administrator to have only one DHCP server running at any time in a cluster. The clustering protocol enables all peers participating in DHCP redundancy to determine the active DHCP server among them. The switch with lowest Redundancy IP is selected as the active DHCP server for the cluster. This selected active DHCP server can be either a primary or standby switch. The other switches do not provide DHCP service as long as the selected DHCP server switch is active.
Auto Revert	Check this box to enable the **Auto Revert** feature and specify the time (in minutes) for the switch to revert. Configure the interval between 1 and 1800 minutes. The default revert time is 5 minutes. When a primary switch fails, the standby switch takes over APs adopted by the primary. If the auto revert feature is enabled, when the failed primary switch comes back up, the standby starts a timer based on the auto-revert interval. At the expiry of auto-revert interval (if the primary switch is still up), the standby switch releases all adopted APs and goes back to a monitoring mode. The expiry timer either will be stopped or restarted if the primary switch goes down and comes up during the auto-revert interval.
Revert Now	Reverts an active fail-over standby switch to a passive standby switch. When a user presses this button, the standby switch will un-adopt all its adopted APs and move into a standby (passive) mode only if all configured members are up again. The revert function does not push APs to the primary switch unless the primary switch has failed over.

3. Refer to the **History** field to view the current state of the redundancy group.

State	Displays the new state (status) of the redundancy group after a Trigger event.
Time	Displays the Timestamp (time zone specific) when the state change occurred.
Trigger	Displays the event causing the redundancy group state change on the switch.
Description	Displays a redundancy event description defining the redundancy group state change on the switch. Typical states include Redundancy Disabled or Redundancy Enabled.

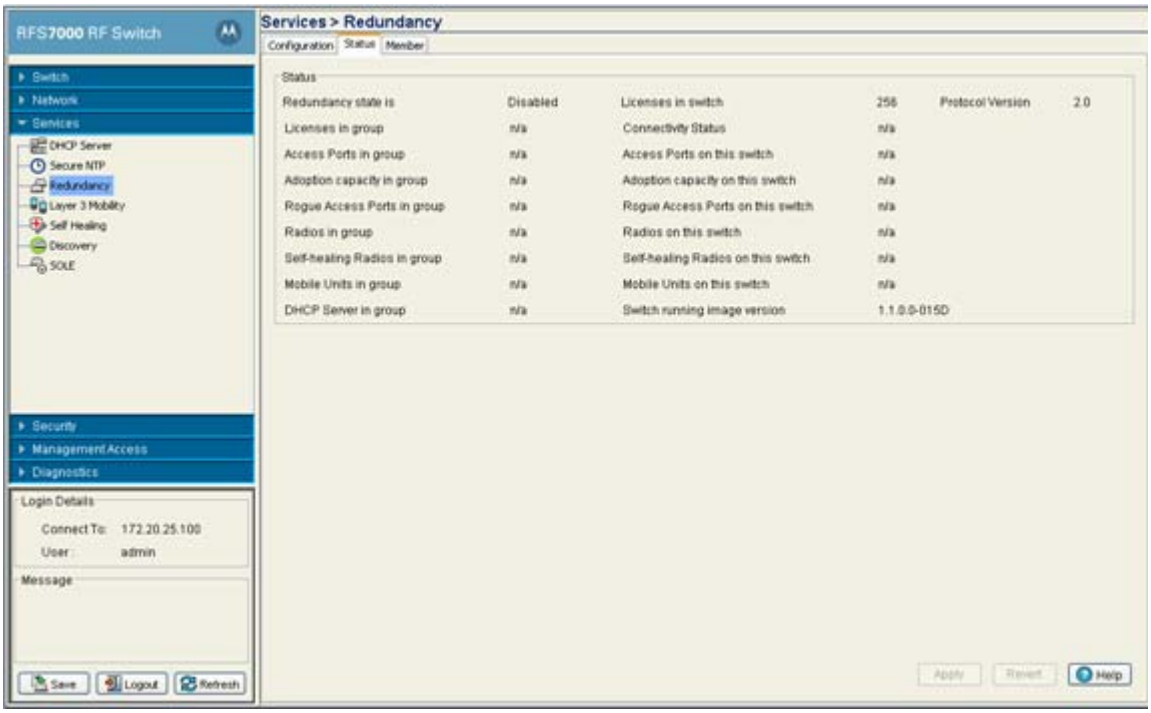
4. Click **Apply** to save any changes to the screen. Navigating away from the screen without clicking the Apply button results in all the changes on the screen being discarded.
5. Click the **Revert** button to undo the changes to the screen and revert to the last saved configuration.

5.4.1 Reviewing Redundancy Status

The switch is capable of displaying the status of the cluster membership. Use this information to assess the overall health and performance of the group.

To configure switch redundancy memberships:

1. Select **Services** > **Redundancy** from the main menu tree.
2. Select the **Status** tab.



3. Refer to the **Status** field to assess the current state of the redundancy group.

Redundancy state is	Displays the state of the redundancy group. When the redundancy feature is disabled, the state is "Disabled." When enabled, it goes to a "Startup" state. From "Startup" it goes to a "Discovery" state immediately if the STP convergence is not enabled. Otherwise, it remains in "Startup" for a period of 50 seconds (the standard STP convergence time). During the discover state, the switch exchanges heartbeats and update messages to discover other members and define the redundancy group license. After discerning memberships, it moves to an Active state. There is no difference in state execution for Primary and Standby modes.
Licenses in switch	Displays the number of licenses installed to adopt access ports on the current switch. For information on licensing rules impacting redundancy group members, see *Redundancy Group License Aggregation Rules on page 5-45*.
Protocol Version	The Cluster Protocol should be set to an identical value for each switch in the redundancy group. The protocol version is one of the parameters used to determine whether two peers can form a group
Licenses in Group	Displays the number of access ports that can be adopted in the redundancy group. This value is calculated when a member starts-up, is added, is deleted or a license changes (downgrade and upgrade.) This value is equal to the highest license level of its members. It is NOT the sum of the license level of its members. For information, see *Redundancy Group License Aggregation Rules on page 5-45*.
Access Ports in group	Displays the total of the number of access ports adopted by the redundancy group.
Adoption capacity in group	Displays the combined AP adoption capability for each radio comprising the cluster. Compare this value with the adoption capacity on this switch to determine if the cluster members have adequate adoption capabilities.
Rogue Access Ports in group	Displays the cumulative number of rogue APs detected by the members of the group. Compare this value with the number of rogues detected by this AP to discern whether an abundance of rogues has been located by a particular switch and thus escalates a security issue with a particular switch.
Radios in group	Displays the combined number (sum) of radios a amongst all the members of the redundancy group.
Self-healing radios in group	Displays the number of radios within the cluster that have self-healing capabilities enabled. Compare this value with the total number of radios within the group to determine how effectively the radios within the cluster can self-heal if problems exist.
Mobile Units in group	Displays the combined number of MU associations for the members of the redundancy group. Compare this number with the number of MUs on this switch to determine how effectively MU associations are distributed within the cluster.
DHCP Server in Group	Displays the total number of DHCP Servers available for DHCP resources for the combined cluster membership.

Connectivity Status	Displays the current connectivity status of the cluster membership.
Access Ports on this switch	Displays the total of the number of access ports adopted by this switch.
Adoption capacity on this switch	Displays the AP adoption capability for this switch. Compare this value with the adoption capacity for the entire cluster to determine if the cluster members (or this switch) have adequate adoption capabilities.
Rogue Access Ports on this switch	Displays the number of rogue APs detected by this switch. Compare this value with the cumulative number of rogues detected by the group to discern whether an abundance of rogues has been located by a particular switch and thus escalates a security issue.
Radios on this switch	Displays the number of radios used with this switch.
Self-healing radios on this switch	Displays the number of radios on this switch with self-healing enabled. Compare this value with the total number of radios within the group to determine how effectively radios can self-heal if problems exist.
Mobile Units on this switch	Displays the number of MUs currently associated with the radio(s) used with this switch. Compare this number with the number of MUs within the group to determine how effectively MUs are distributed within the cluster.

4. The **Apply** and **Revert** buttons are unavailable for use with the Status screen, as there are no editable parameters to save or revert.

5.4.2 Configuring Redundancy Group Membership

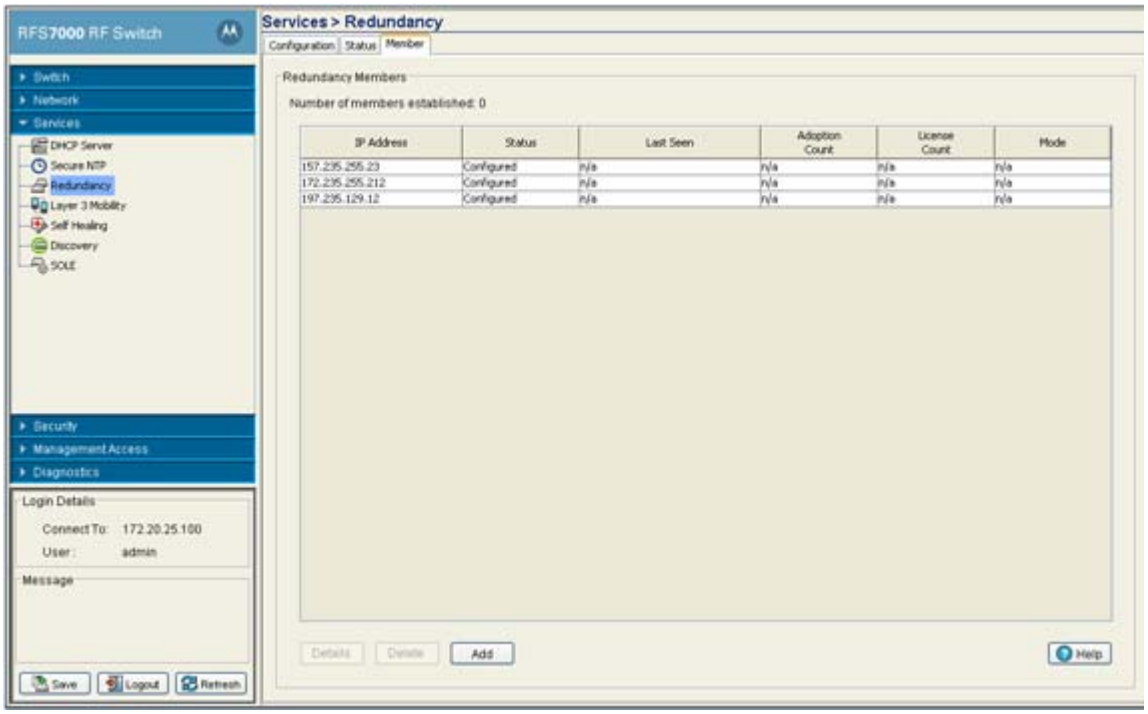
The redundancy group should be disabled to conduct an Add/Delete operation. There are a minimum of 2 members needed to comprise a Redundancy Group, including the initiating switch

To configure switch redundancy memberships:

1. Select **Services** > **Redundancy** from the main menu tree.

   The Redundancy screen displays with the Configuration tab selected.

2. Select the **Member** tab.



3. Refer to the following information within the Member tab:

IP Address	Displays the IP addresses of the selected redundancy group member.
Status	Displays the current status of this group member. This status could have the following values: • *Configured* - The member is configured on the current switch. • *Seen* - Heartbeats can be exchanged between the current switch and this member. • *Invalid* - Critical redundancy configuration parameter(s) of the peer (heartbeat time, discovery time, hold time, Redundancy ID, Redundancy Protocol version of this member) do not match this switch's parameters. • *Not Seen* - The member is no longer seen by this switch. • *Established* - The member is fully established with this current module and licensing information already been exchanged between this switch and the member.
Last Seen	Displays the time when this member was last seen by the switch.
Adoption Count	Displays the number of access ports adopted by this member.
License Count	Displays the number of licenses installed on this member. For information on licensing rules impacting redundancy group members, see *Redundancy Group License Aggregation Rules on page 5-45*.
Mode	The Redundancy Mode could be Active or Standby depending on the mode configuration on the member. Refer to the Configuration screen to change the mode.

4. Select a row, and click the **Details** button to display additional details for this member. For more information, see *Displaying Redundancy Member Details on page 5-43*.
5. Select a row and click the **Delete** button to remove a member from the redundancy group. The redundancy group should be disabled to conduct an Add or Delete operation.
6. Click the **Add** button to add a member to the redundancy group. The redundancy group should be disabled to conduct an Add or Delete operation. For more information, see *Adding a Redundancy Group Member on page 5-45*.

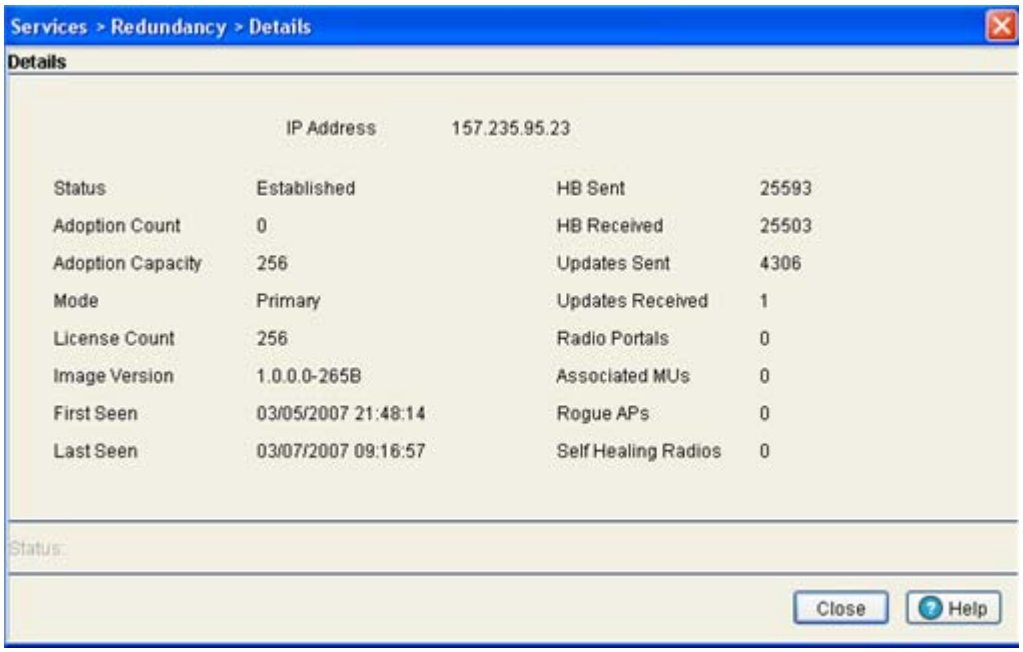
5.4.2.1 Displaying Redundancy Member Details

Use the **Details** screen (in conjunction with its parent Member screen) to display additional (more detailed) information on the group member selected within the Member screen.

To review the details

1. Select **Services** > **Redundancy** from the main menu tree.

   The Redundancy screen displays with the Configuration tab selected.
2. Select the **Member** tab.
3. Highlight a member of the group and select the **Details** button.



4. Refer to the following redundancy member information:

IP Address	Displays the IP addresses of the members of the redundancy group. There are a minimum of 2 members needed to define a redundancy group, including this current module

Status	Displays the current status of this group member. This status could have the following values: • *Configured* - The member is configured on the current wireless service module. • *Seen* - Heartbeats can be exchanged between the current switch and this member. • *Invalid* - Critical redundancy configuration parameter(s) of the peer (heartbeat time, discovery time, hold time, Redundancy ID, Redundancy Protocol version of this member) do not match this switch's parameters. • *Not Seen* - The member is no more seen by this switch. • *Established* - The member is fully established with this current module and licensing information already been exchanged between this switch and the member.
Adoption Count	Displays the number of access ports adopted by this member.
Adoption Capacity	Displays the maximum number of access ports the member is licensed to adopt. For information on licensing rules impacting redundancy group members, see *Redundancy Group License Aggregation Rules on page 5-45*.
Mode	The Redundancy Mode could be Active or Standby depending on the mode configuration on the member. Refer to the Configuration screen to change the mode
License Count	Displays the number of port licenses available for this switch. For information on licensing rules impacting redundancy group members, see *Redundancy Group License Aggregation Rules on page 5-45*.
Image Version	Displays the image version currently running on this member. Is the selected version complimentary with this switch's version?
First Seen	Displays the time this member was first seen by the switch.
Last Seen	Displays the time this member was last seen by the switch.
HB Sent	Displays the number of heartbeats sent from the switch to this member since the last reboot of the switch.
HB Received	Displays the number of heartbeats received by the switch since the last reboot.
Updates Sent	Displays the number of updates sent from the switch since the last reboot. Updates include, authorization level, group authorization level and number of access ports adopted.
Updates Received	Displays the number of updates received by the current switch from this member since the last reboot.
Radio Portals	Displays the number of radio portals detected on each redundancy member listed.
Associated MUs	Display the number of MUs associated with each member listed.
Rogue APs	Displays the number of Rogue APs detected by each member. Use this information to discern whether these radios represent legitimate threats to other members of the redundancy group.

Self Healing Radios	Displays the number of self healing radios on each detected member. These radios can be invaluable if other radios within the redundancy group were to experience problems requiring healing by another radio.

5. Refer to the **Status** field.

   The Status is the current state of the requests made from the applet. Requests are any "SET/GET" operation from the applet. The Status field displays error messages if something goes wrong in the transaction between the applet and the switch.

6. Click **Close** to close the dialog without committing updates to the running configuration.

5.4.2.2 Adding a Redundancy Group Member

Use the **Add** screen as the means to add a new member (by adding their IP address) to an existing redundancy group (cluster).

To add a new member to a redundancy group:

1. Select **Services** > **Redundancy** from the main menu tree.

   The Redundancy screen displays with the Configuration tab selected.

2. Select the **Member** tab.
3. Select the **Add** button.

4. Enter the IP Address of the new member.
5. Click **OK** to save and add the changes to the running configuration and close the dialog.
6. Refer to the **Status** field.

   The Status is the current state of the requests made from the applet. Requests are any "SET/GET" operation from the applet. The Status field displays error messages if something goes wrong in the transaction between the applet and the switch.

7. Click **Cancel** to close the dialog without committing updates to the running configuration.

5.4.3 Redundancy Group License Aggregation Rules

The following are rules governing license usage amongst members of a redundancy group:

- A redundancy group license is determined by adding individual switch licenses.

- Do not allow different port speed/duplex settings on members. Each members should have the settings.
- In a redundancy group of three switches (S1, S2 and S3), if S1 has X licenses, S2 has Y licenses and S3 has Z licenses, the license count is X+Y+Z (the aggregation of each switch).
- A cluster license is re-calculated whenever a new switch brings existing licenses to a group or an existing switch's license value changes (increases or decreases).
- A simple switch reboot will not initiate a new cluster license calculation, provided the re-booted switch does not come up with different installed license.
- A change to an installed license during runtime initiates a cluster license calculation.
- If an existing redundancy group member goes down, it will not initiate a cluster license calculation.
- Whenever the cluster protocol is disabled, a member switch forgets the learned cluster license as well as peer information needed to compute license totals.
- If the switch start-up configuration is removed, a member switch forgets the learned cluster license as well as peer information needed to compute license totals.
- If adding a new switch (with zero or non-zero installed license) to a group with at least one license contributing switch down, the new group member will receive a different cluster license value.

  For example, for a cluster of three switches (S1 = 6, S2 = 6 and S3 = 6 licenses), the group license count is 18. If S1 goes down, the license count is still 18, since the license calculation is not initiated if a member switch goes down. If S4 (with zero licenses) is introduced, S4 becomes part of the group (can exchange updates and other packets), but has license count of 12 (NOT 18), even though S2 and S3 still show a license count of 18. This should be an indicator a new member has been introduced during a period when the redundancy group is not operating with all its license contributing members.

5.5 Layer 3 Mobility

Refer to the following sections to configure Layer 3 Mobility:

- *Configuring Layer 3 Mobility*
- *Defining the Layer 3 Peer List*
- *Reviewing Layer 3 Peer List Statistics*
- *Reviewing Layer 3 MU Status*

5.5.1 Configuring Layer 3 Mobility

Layer 3 mobility is a mechanism enabling a MU to maintain the same Layer 3 address while roaming throughout a multi-VLAN network. This enables transparent routing of IP datagrams to MUs during their movement, so data sessions can be maintained while they roam (in for voice applications in particular). Layer 3 mobility maintains TCP/UDP sessions in spite of roaming among different IP subnets.

A mobility domain comprises of a network of switches among which an MU can roam seamlessly without changing its IP address. Each switch in the mobility domain needs a mobility domain string identifier so MUs roaming between switches can retain their Layer 3 address and maintain application-layer connectivity.

When a MU enters a mobility domain (by associating with a switch), it is first assigned a home switch. The home switch is responsible for assigning a VLAN for the MU and communicating the MU's mobility-related parameters to the other switches in the mobility domain. The home switch does not change for the remainder of the MU's presence in the mobility domain. All data packets transmitted/received by the MU including DHCP

and ARP are tunneled through the home switch. The IP address for the MU is assigned from the VLAN to which the MU belongs (as determined by the home switch).

The current switch is the switch in the mobility domain an MU is currently associated to. The current switch changes as the MU roams and establishes different associations. The current switch is responsible for delivering data packets from the MU to its home switch and vice-versa.

CAUTION An access port is required to have a DHCP provided IP address before attempting layer 3 adoption, otherwise it will not work. Additionally, the access port must be able to find the IP addresses of the switches on the network. To locate switch IP addresses on the network:

- Configure DHCP option 189 to specify each switch IP address.
- Configure a DNS Server to resolve an existing name into the IP of the switch. The access port has to get DNS server information as part of its DHCP information. The default DNS name requested by an AP300 is "Symbol-CAPWAP-Address". However, since the default name is configurable, it can be set as a factory default to whatever value is needed.

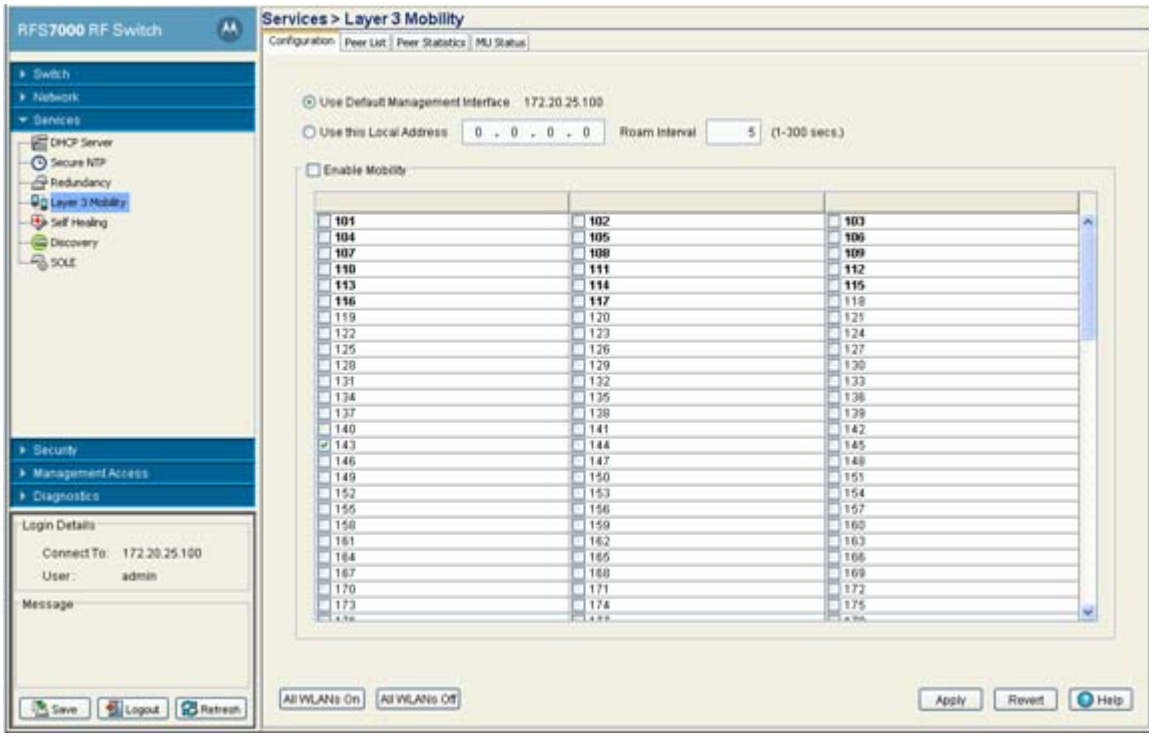
Key aspects of Layer 3 Mobility include:

- Seamless MU roaming between switches on different Layer 3 subnets, while retaining the same IP address.
- Static configuration of mobility peer switches.
- Layer 3 support does not require any changes to the MU. In comparison, other solutions require special functionality and software on the MU. This creates numerous inter-working problems with working with MUs from different legacy devices which do not support Layer
- Support for a maximum of 20 peers, each handling up to a maximum of 500 MUs.
- Data traffic for roamed MUs is tunneled between switches by encapsulating the entire L2 packet inside GRE with a proprietary code-point.
- When MUs roam within the same VLAN (L2 Roaming), the behavior is retained by re-homing the MU to the new switch so extra hops are avoided while forwarding data traffic.
- MUs can be assigned IP addresses statically or dynamically.
- Forward and reverse data paths for traffic originating from and destined to MUs that have roamed from one L3 subnet to another are symmetric.

To configure Layer 3 Mobility for the switch:

1. Select **Services** > **Layer 3 Mobility** from the main menu tree.

The **Layer 3 Mobility** screen appears with the Configuration tab displayed.



2. Select the **Use Default Management Interface** checkbox to use the switch's default management interface IP address for MUs roaming amongst different Layer 3 subnets. The IP address displayed to the right of the checkbox is used by Layer 3 MU traffic.
3. If wanting to use a local IP addresses (non switch management interface) for MUs roaming amongst different Layer 3 subnets, select the **Use this Local Address** checkbox and enter an IP address.
4. Use the **Roam Interval** to define the maximum length of time MUs within selected WLAN are allowed to roam amongst different subnets.
5. Refer to the table of WLANs and select the checkboxes of those WLANs you wish to enable Layer 3 mobility for.

   Once the settings are applied, MUs within these WLANs can roam amongst different subnets.
6. Select the **Enable Mobility** checkbox to enable a MU to maintain the same Layer 3 address while roaming throughout a multi-VLAN network.
7. Select the **All WLANs On** button to enable mobility for each WLAN listed.

   If unsure if you want to enable mobility for each WLAN, manually select just those you want to enable.
8. Select the **All WLANs Off** button to disable mobility for each WLAN listed.
9. Click the **Apply** button to save the changes made within this screen. Clicking Apply overwrites the previous configuration.
10. Click the **Revert** button to disregard any changes made within this screen and revert back to the last saved configuration.

5.5.2 Defining the Layer 3 Peer List

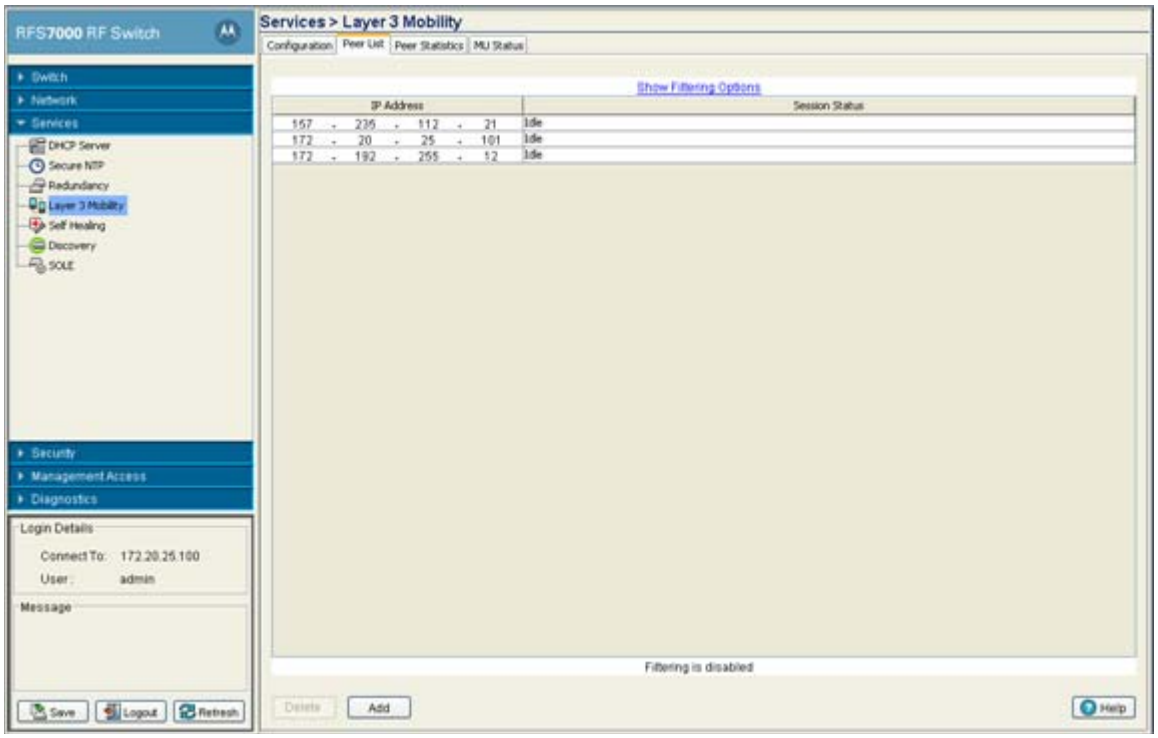
The Layer 3 Peer List contains the IP addresses MUs are using to roam amongst various subnets. This screen is helpful in displaying the IP addresses available to those MUs requiring access to different subnet resources.

To define the Layer 3 Peer List:

1. Select **Services** > **Layer 3 Mobility** from the main menu tree.

   The **Layer 3 Mobility** screen appears with the Configuration tab displayed.

2. Select the **Peer List** tab.

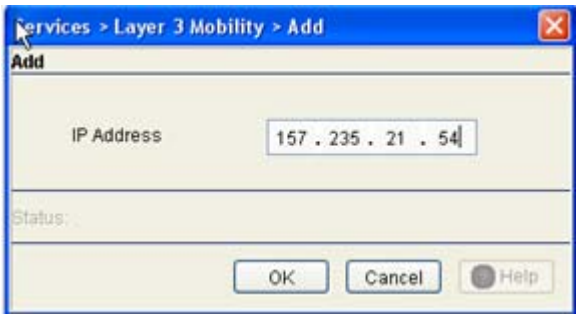


3. Refer to the contents of the Peer List for existing IP addresses and Layer 3 MU session status.

   Use this information to determine whether a new IP address needs to be added to the list or an existing address needs to be removed.

4. Select an IP address from those displayed and click the **Delete** button to remove the address from the list available for MU Layer 3 roaming amongst subnets.

5. Click the **Add** button to display a screen used for adding the IP address to the list of addresses available for MU Layer 3 roaming.



Enter the IP addresses in the area provided and click the **OK** button to add the addresses to the list displayed within the **Peer List** screen.

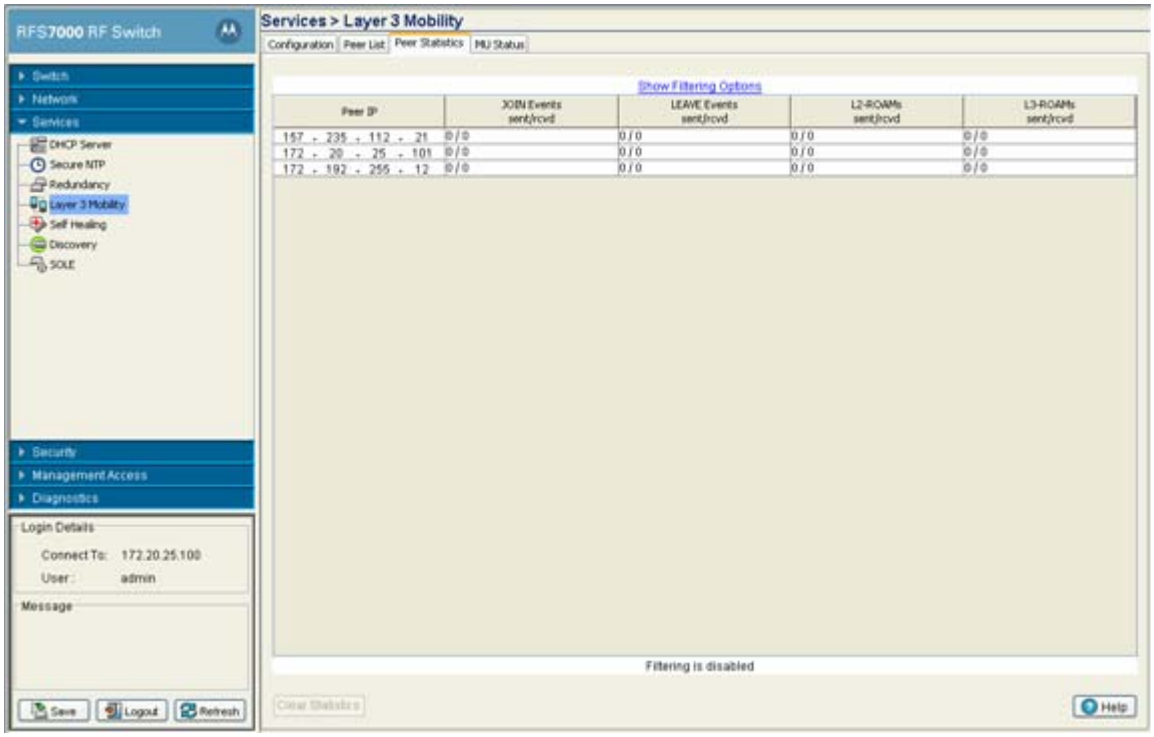
5.5.3 Reviewing Layer 3 Peer List Statistics

When a MU roams to a current switch on the same layer 3 network, it sends a L2-ROAM message to the home switch to indicate the MU has roamed within the same VLAN. The old home switch forwards the information to all its peers. The MU is basically re-synchronized to the new current switch, but keeps its old IP address. The same procedure is followed, even if the new current switch is on a different layer 3 subnet, but uses the same VLAN ID (overlapping VLAN scenario).

Tracking these message counts is important to gauge the behavior within the mobility domain.The Layer 3 Mobility screen contains a tab dedicated to tracking the message sent between the current switch, home switch and MU.

To view layer 3 peer statistics

1. Select **Services** > **Layer 3 Mobility** from the main menu tree.
2. Select the **Peer Statistics** tab.



3. Refer to the following information within the Peer Statistics tab:

Peer IP	Displays the IP addresses of the peer switches within the mobility domain. Each peer can support up to 500 MUs.

JOIN Events sent/rcvd	Displays the number of JOIN messages sent and received. JOIN messages advertise the presence of MUs entering the mobility domain for the first time. When a MU (currently not present in the MU database) associates with a switch, it immediately sends a JOIN message to the host switch with MAC, VLAN and IP information (both current and home switch IP info). The home switch forwards the JOIN to all its peers (except the one from which it received the original message). JOIN messages are always originated by the current switch. JOIN messages are also used during the home switch selection phase to inform a candidate home switch about a MU. The current switch selects the home switch (based on its local selection mechanism) and sends a JOIN message to the home switch that is forwarded it to all its peers.
LEAVE Events sent/rcvd	Displays the number of LEAVE messages sent and received. LEAVE messages are sent when the switch decides a MU originally present in the MU database is no longer present in the mobility domain. The criterion to determine the MU has actually left the network is implementation specific. The current switch sends the LEAVE message with the MU's MAC address information to the home switch, which eventually forwards the message to each mobility peer.
L2-ROAMs sent/rcvd	Displays the number of Layer 2 ROAM messages sent and received. When a MU roams to a new switch on a different layer 3 network (MU is mapped to a different VLAN ID), it sends a L3-ROAM message to the home switch with the new IP information for the current switch it is associated with. The L3-ROAM message is then forwarded by the home switch to each peer.
L3-ROAMs sent/rcvd	Displays the number of Layer 3 ROAM messages sent and received. When a MU roams to a new current switch (on the same layer 3 subnet as the old current switch), it sends a L2-ROAM message to the old home switch with the new home switch-IP and current switch-IP information. This L2-ROAM message is then forwarded by the old home switch to each peer.

4. Click the **Clear Statistics** button to remove the data displayed for the selected peer IP address.

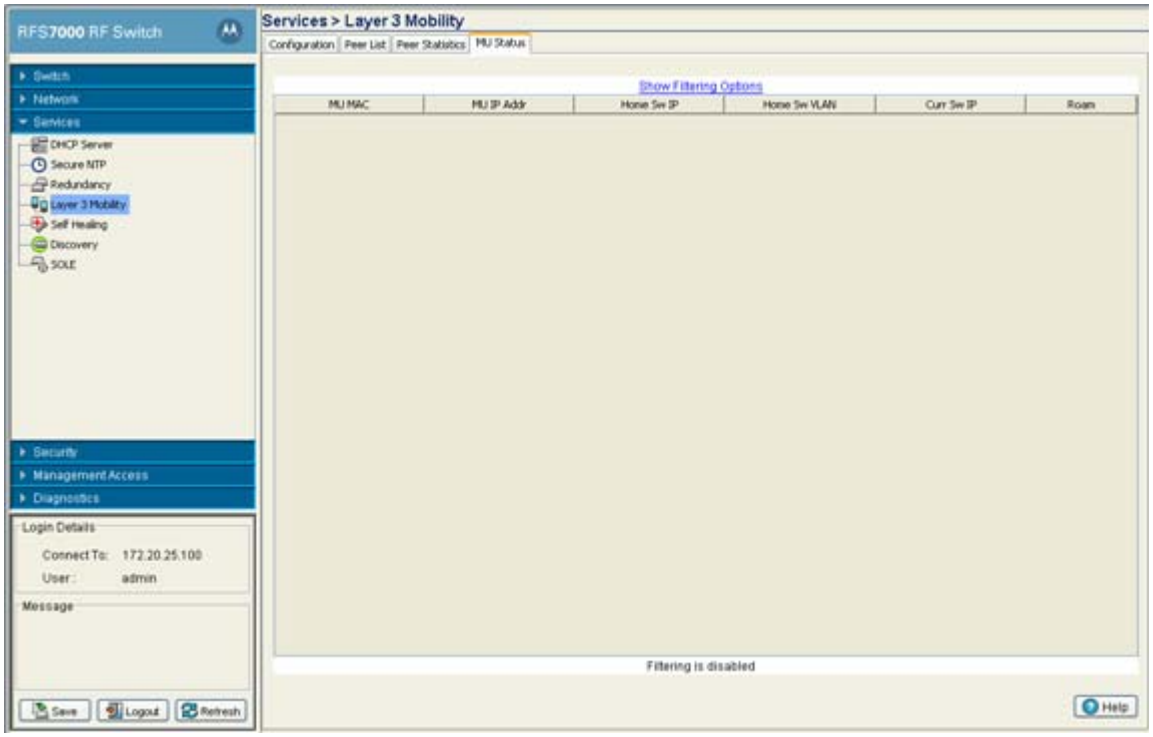
5.5.4 Reviewing Layer 3 MU Status

The Layer 3 Mobility **MU Status** tab displays a set of MU stats for associated MUs within the mobility domain. Use the MU status information to familiarize yourself with these MUs and their mobility-related parameters to distinguish new MUs entering the network from existing MUs roaming within the mobility domain.

To view Layer 3 mobility MU statistics

1. Select **Services** > **Layer 3 Mobility** from the main menu tree.

2. Select the **MU Status** tab.



3. Refer to the following information within the MU Status tab:

MU MAC	Displays the factory hardcoded MAC address of the MU. This value is set at the factory and cannot be modified. Thus, it should be consistent as the MU roams within the mobility domain.
MU IP Addr	Displays the IP address the MU is using within the mobility domain. Again, this may not be the IP address used by the MU for initial association with the switch, but it is the IP address set for the MU to roam amongst subnets. For more information, see *Configuring Layer 3 Mobility on page 5-46*.
Home Sw IP	Displays the MU's home switch IP address. This is the IP address of the switch the MU is initially associated with, before roaming across subnets as part of its layer 3 mobility activity.
Home Sw VLAN	Displays the MU's home switch VLAN identifier. This is the VLAN index value set for the MU when it was originally configured as part of a VLAN with its home switch.
Curr Sw IP	Displays the IP address of the switch the MU is currently associated to within the mobility domain.
Roam	Displays whether the MU has roamed (with a checkmark) or has not roamed (with an X).

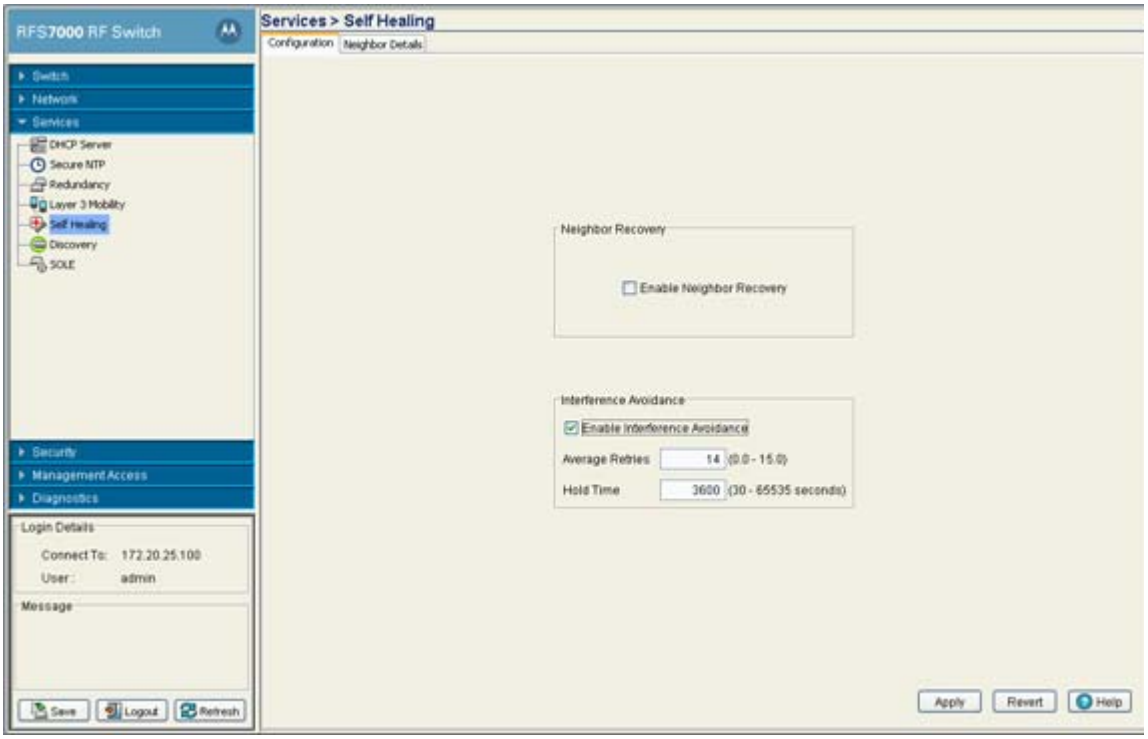
5.6 Configuring Self Healing

The switch supports a feature called *Self Healing* that enables radios to take corrective action when one or more radios fail. To enable the feature the user must specify radio neighbors that would self heal if either one goes down. The neighbor radios do not have to be of the same type. Therefore, an 11bg radio can be the neighbor of a 11a radio and either of them can self heal when one of them fails.

The switch initiates self healing when it looses communication with the access port or when another radio (configured in detector mode) informs the switch a particular radio is not transmitting beacons.

To configure self-healing on the switch:

1. Select **Services** > **Self Healing** from the main menu tree.



2. Select the **Enable Neighbor Recovery** checkbox.

   Enabling Neighbor Recovery is required to conduct manual neighbor detection.

3. Refer to the **Interference Avoidance** field to define the following settings:

Enable Interference Avoidance	When enabled, the switch is capable of switching channels on an access port (*Automatic Channel Selection*) if interference is observed on the current operating channel.
Average Retries	Displays the average number of retries for a MU to communicate with a neighbor radio. Define a retry value between 0.0 and 15.0 retry attempts. Average Retries is a threshold value, when exceeded ACS is initiated.
Hold Time	Set the interval (in seconds) that disables interference avoidance after detection. The hold time prevents the radio from re-running ACS continuously.

4. Click the **Apply** button to save the changes made within this screen. Clicking Apply overwrites the previous configuration.
5. Click the **Revert** button to disregard any changes made within this screen and revert back to the last saved configuration.

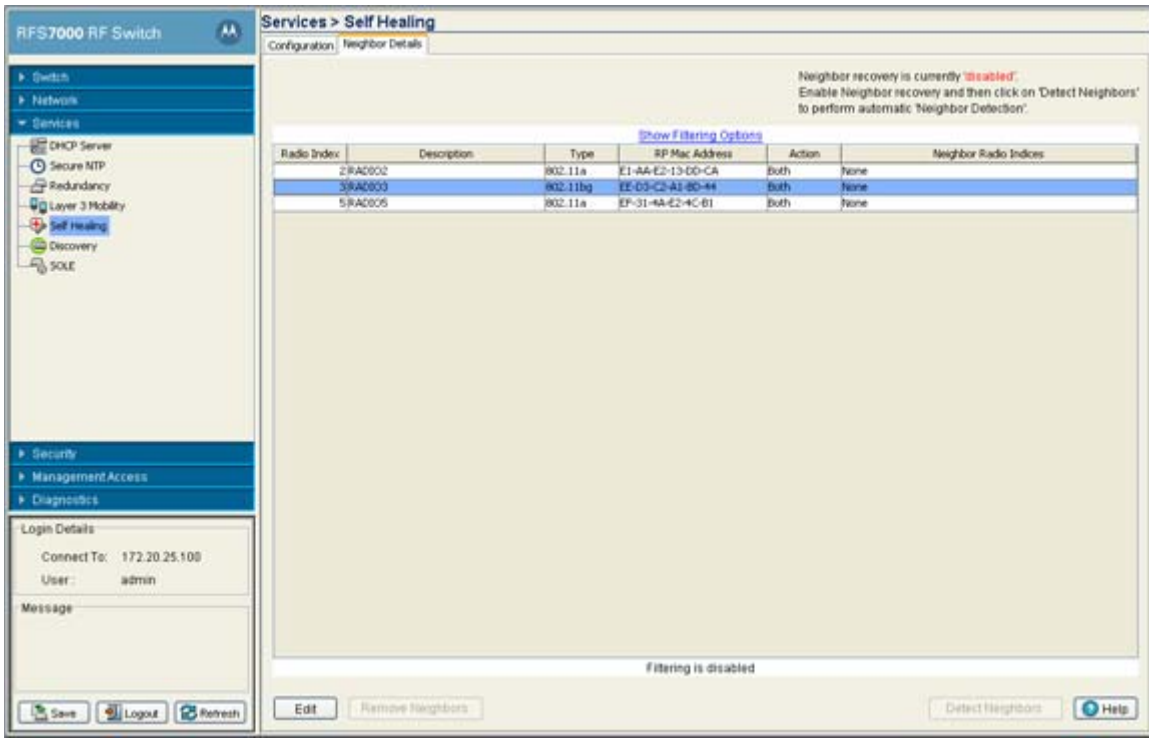
5.6.1 Configuring Self Healing Neighbor Details

The Neighbor Details page displays all the radios configured on the switch and their neighbor designations.

To configure self-healing on the switch:

1. Select **Services** > **Self Healing** from the main menu tree.

   The Self Healing page launches with the **Configuration** tab displayed.
2. Select the **Neighbor Details** tab.



   The top right-hand corner displays whether neighbor recovery is currently enabled or disabled. To change the state, click the **Enable Neighbor Recovery** checkbox within the Configuration tab.
3. Refer to the following information as displayed within the Neighbor Recovery screen.

Radio Index	Displays a numerical identifier used (in conjunction with the radio's name) to differentiate the radio from its peers.
Description	Displays a text description used (in conjunction with the radio's index) to differentiate the radio from its peers.
Type	Displays the radio as either a 802.11a or 802.11bg radio.
RP MAC Address	Displays the Ethernet MAC address of the access port. Use the Access Port MAC Address for the addition or deletion of the radio.

Action	Displays the self healing action configured for the radio. Options include: • *Raise Power* - The transmit power of the radio is increased when a neighbor radio is not functioning as expected. • *Open Rates* - Data rates are decreased to support all rates when a neighbor radio is not functioning as expected. • *Both* - Increases power and data rate when a neighbor radio is not functioning as expected. • *None* - No action is taken when a neighbor radio is not functioning as expected.
Neighbor Radio Index	Displays the indexes of the radio's neighbors.

4. Highlight an existing neighbor and click the **Edit** button to launch a screen designed to modify the self healing action and/or neighbors for the radio. For more information, see *Editing the Properties of a Neighbor on page 5-55*.
5. Select the **Remove Neighbors** button to remove all neighbors from the selected radio's neighbor list.
6. Click the **Detect Neighbors** button to auto-determine neighbors for the radios.

NOTE The **Detect Neighbors** button is enabled only when the **Enable Neighbor Recovery** checkbox is selected from within the Configuration tab. Ensure this option has been enabled before trying to detect neighbors.

Enabling this feature automatically makes each radio disassociate with their attached MUs, clear the current neighbor list and move into detection mode to detect neighboring radios.

Neighbor detection works best if all radios are configured and adopted. Starting the automatic neighbor detection feature disassociates MUs and clears the current neighbor configuration.

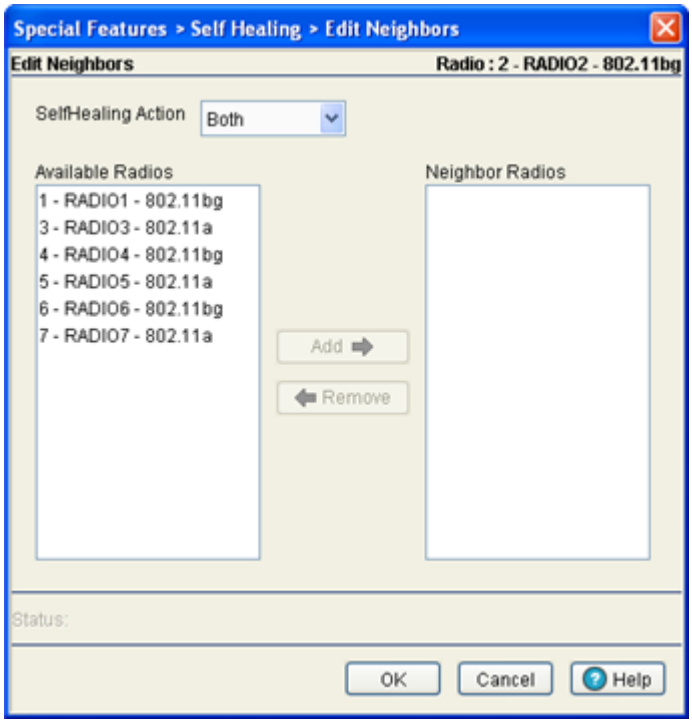
5.6.1.1 Editing the Properties of a Neighbor

Use the **Edit** screen to specify the neighbor of a selected radio and the action the radio performs in the event its neighbor radio fails.

To edit the properties of a neighbor:

1. Select **Services** > **Self Healing** from the main menu tree.
2. Select the **Neighbor Details** tab.

3. Select an existing neighbor and click the **Edit** button.



   The radio index and description display in the upper right corner of the screen. The **Available Radios** value represents the radios that can be added as a neighbor for the target radio. **Neighbor Radios** are existing radios (neighbors).

4. Select one of the following four actions from the Self Healing Action drop-down menu:
   - *None* - The radio takes no action at all when a neighbor radio fails.
   - *Open Rates* - The radio will default to factory-default rates when a neighbor radio fails. Reboot the system to invoke factory default settings.
   - *Raise Power* - The radio raises its transmit power to the maximum provided its power is lower than the maximum permissible value.
   - *Both* - The radio increases power and data rate when a neighbor radio is not functioning as expected.
5. Click the **Add ->** button to move a radio from the Available Radios list to the Neighbor Radios list. This dedicates neighbors for this radio.
6. Select a radio and click **<- Remove** to move the radio from the Neighbor Radios list to the Available Radios list.
7. Refer to the **Status** field for an update of the edit process.

   The Status is the current state of the requests made from the applet. Requests are any "SET/GET" operation from the applet. The Status field displays error messages if something goes wrong in the transaction between the applet and the switch.
8. Click **OK** to save the changes to the running configuration and close the dialog.
9. Click **Cancel** to close the dialog without committing updates to the running configuration.

5.7 Configuring Switch Discovery

Switch discovery enables the SNMP discovery (location) of devices. To discover devices in the specified range of IP addresses, the switch Web UI sends SNMP GET requests (using the user specified SNMP v2 or v 3 version) to all IP addresses on the specified network. The results of the discovery are helpful for isolating devices compatible for operation with the locating switch, thus extending the potential coverage area and MU support base within the switch managed network.

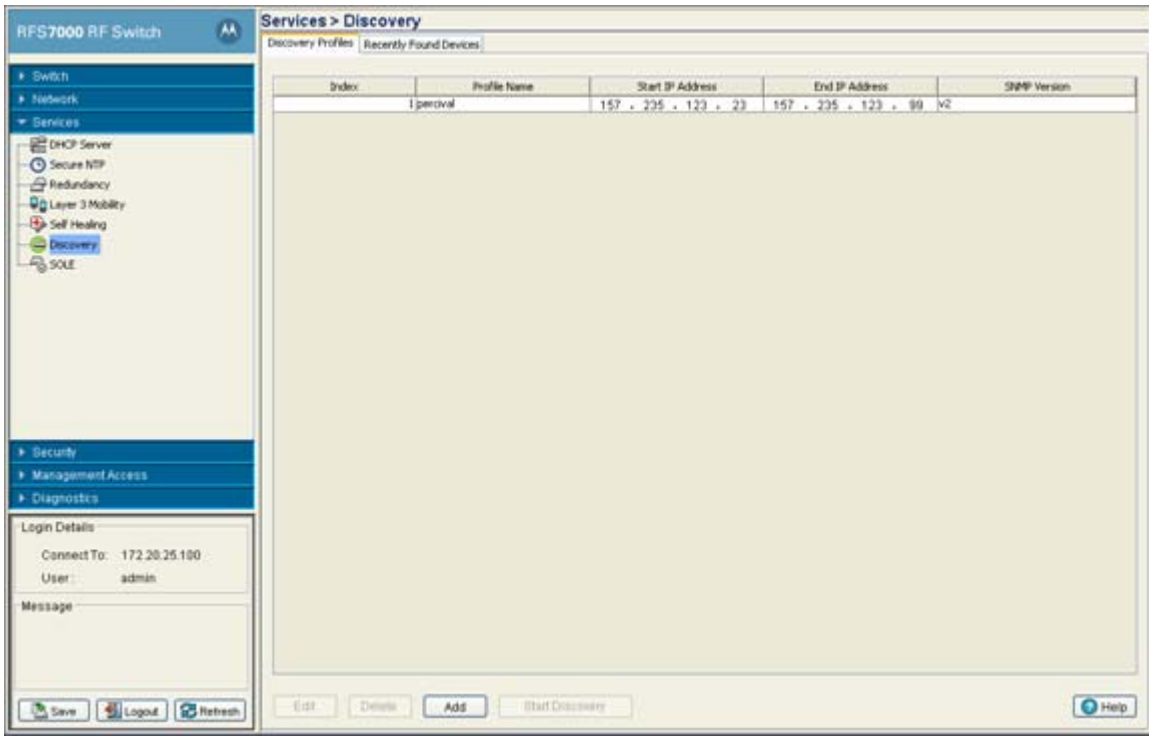
Use the **Discovery Profiles** tab to view existing SNMP search profiles using a user defined range of IP addresses. Existing profiles can be modified or deleted and new profiles can be added as needed. Refer to the **Recently Found Devices** tab to view a table of devices discovered by the current discovery process. Each discovered device compatible with the locating switch is displayed in a shaded color to distinguish it from non-compatible devices.

CAUTION Switch discovery can be a time consuming operation. However, the switch discovery operation is a standalone process. This allows users to perform other configuration operations when discovery is running in the background.

5.7.1 Configuring Discovery Profiles

To configure switch discovery:

1. Select **Services** > **Discovery** from the main menu tree.



2. Refer to the following information within the Discovery Profiles tab to discern whether an existing profile can be used as is, requires modification (or deletion) or if a new discovery profile is required.

Index	Displays the numerical identifier used to differentiate this profile from others with similar configurations. The index is supplied to new profiles sequentially.
Profile Name	Displays the user-assigned name for the profile. The profile name should associate the profile with the group of devices or area where the discovered devices are anticipated to be located.
Start IP Address	Displays the starting numeric (non DNS) IP address from where the search for available network devices is conducted.
End IP Address	Displays the ending numeric (non DNS) IP address from where the search for available network devices is conducted.
SNMP Version	Displays the version of the SNMP (either SNMP v2 or v3) used for discovering available network devices.

3. Select an existing profile and click the **Edit** button to modify the profile name starting and ending IP address and SNMP version. Motorola recommends editing a profile only if some of its attributes are still valid, if the profile is obsolete, delete it and create a new one.
4. Select an existing profile and click the **Delete** button to remove this profile from the list of available profiles.
5. Click the **Add** button to display a screen used to define a new switch discovery profile. For more information, see *Adding a New Discovery Profile on page 5-59*.
6. Click the **Start Discovery** button to display a **Read Community String** (SNMP v2) or V3 **Authentication** (SNMP v3) screen.

   Storing SNMP credentials as a string within a switch's discovery profile table (SNMP table) can compromise switch security. Therefore, when Start Discovery is selected, the switch prompts the user to verify their SNMP credentials against the SNMP credentials of discovered devices. SNMP v2 and v3 credentials must be verified before the switch displays discovered devices within the Recently Found Devices table.

   If SNMP v2 is used with a discovering profile, a **Read Community String** screen displays.The Community String entered is required to match the name used by the remote network management software of the discovered switch.

If SNMP v3 is used with a discovering profile, a **V3 Authentication** screen displays. The User Name and Password are required to match the name used by the remote network management software of the discovered switch

When the credentials of the V2 Read Community or V3 Authentication screens are satisfied, the switch discovery process begins.

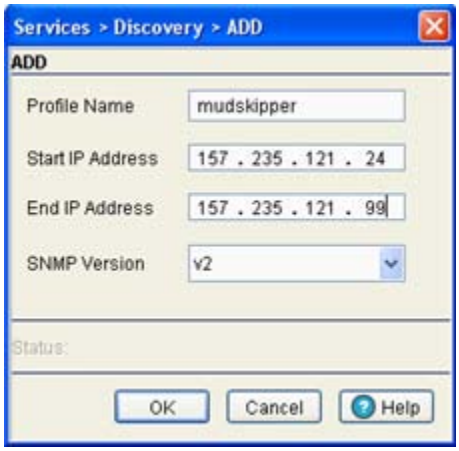
7. If necessary, click the **Stop Discovery** button (enabled only during the discovery operation) to stop the discovery operation.

5.7.1.1 Adding a New Discovery Profile

If the contents of an existing profile are no longer relevant to warrant modification using the Edit function, then a new switch discovery profile should be created.

To create a new switch discovery profile:

1. Select **Services** > **Discovery** from the main menu tree.
2. Click the **Add** button at the bottom of the screen.



3. Define the following parameters for the new switch discovery profile:

Profile Name	Define a user-assigned name used to title the profile. The profile name should associate the profile with the group of devices or area where the discovered devices should be located.
Start IP Address	Enter the starting numeric (non DNS) IP address from where the search for available network devices is conducted.
End IP Address	Enter the ending numeric (non DNS) IP address from where the search for available network devices is conducted

SNMP Version	Use the drop-down menu to define the SNMP version (either v2 or v3) used for discovering available network devices.

4. Refer to the **Status** field for an update of the edit process.

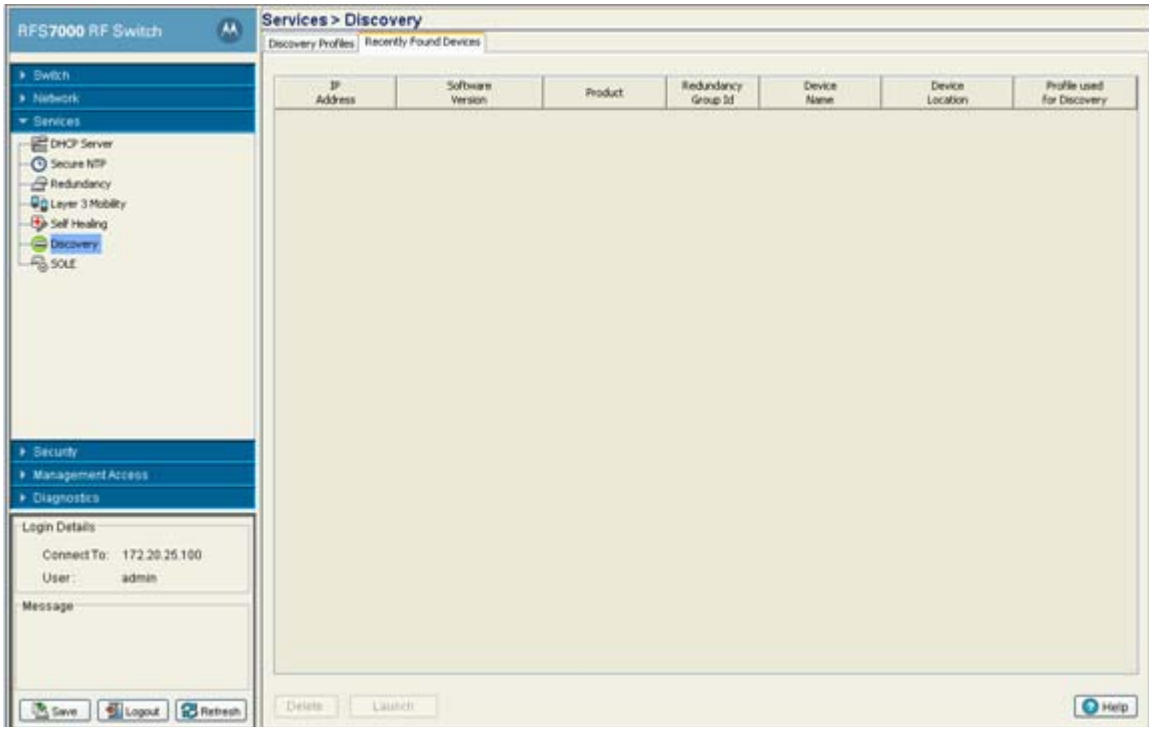
   The Status is the current state of the requests made from the applet. Requests are any "SET/GET" operation from the applet. The Status field displays error messages if something goes wrong in the transaction between the applet and the switch.
5. Click **OK** to save the changes to the running configuration and close the dialog.
6. Click **Cancel** to close the dialog without committing updates to the running configuration.

5.7.2 Viewing Recently Found Devices

Refer to the **Recently Found Devices** tab to view a table of devices found by the discovery process. Each discovered device compatible with the locating switch (running switch software version 1.1 or higher) is displayed in a shaded color to distinguish it from non-compatible devices. The switch Web UI enables users display the Web UI of the discovered device in a separate browser window.

To view the devices located by the switch:

1. Select **Services** > **Discovery** from the main menu tree.
2. Select the **Recently Found Devices** tab.



3. Refer to the following within the Recently Found Devices tab to discern whether a located device should be deleted from the list or selected to have its Web UI launched and its current configuration modified.

IP Address	Displays the IP address of the discovered switch. This IP address obviously falls within the range of IP addresses specified for the discovery profile used for the device search. If the IP addresses displayed do not meet your search expectations, consider creating a new discovery profile and launching a new search.
Software Version	Displays the software version running on the discovered device.
Product	Displays the name of the device discovered by the device search. If the list of devices discovered is unsatisfactory, consider configuring a new discovery policy and launching a new search.
Redundancy Group Id	If the discovered device is part of a cluster (redundancy group), its cluster ID displays within this column. The Redundancy ID would have been assigned using the Switch > Redundancy screen.
Device Name	Displays the device name assigned to the discovered device. This name would have been assigned using the Switch > Configuration screen.
Device Location	Displays the device location defined to the discovered device. The location would have been assigned using the Switch > Configuration screen.
Profile used for Discovery	Displays the profile selected from within the Discovery Profiles tab and used with the Start Discovery function to discover devices within the switch managed network. If the group of devices discovered and displayed within the Recently Found Devices tab does not represent the device demographic needed, consider going back to the Discovery Profiles tab and selected a different profile for the switch discovery process.

4. If a discovered switch is of no interest, select it from amongst the discovered devices displayed and click the **Delete** button.

   Once removed, the located device cannot be selected and its Web UI displayed.

5. Select a discovered device from amongst those located and displayed within the Recently Found Devices screen and click the **Launch** button to display the Web UI for that switch.

CAUTION When launching the Web UI of a discovered device, take care not to make configuration changes rendering the device ineffective in respect to its current configuration.

5.8 Configuring SOLE Support

The switch has the ability to use *Smart Opportunistic Location Engine* (SOLE) adapters to assist in the locationing of devices within the switch managed network. The switch currently supports the use of AeroScout SOLE adapters.

AeroScout adapters use standard wireless networks to locate assets and utilize the switch managed network to assist in asset tracking, process automation, theft prevention and increased utilization and bandwidth. The AeroScout engine processes information received from the switch to produce location and presence data for assets tagged with AeroScout's Wi-Fi-based RFID Tags. For SOLE configuration and support data, refer to the following:

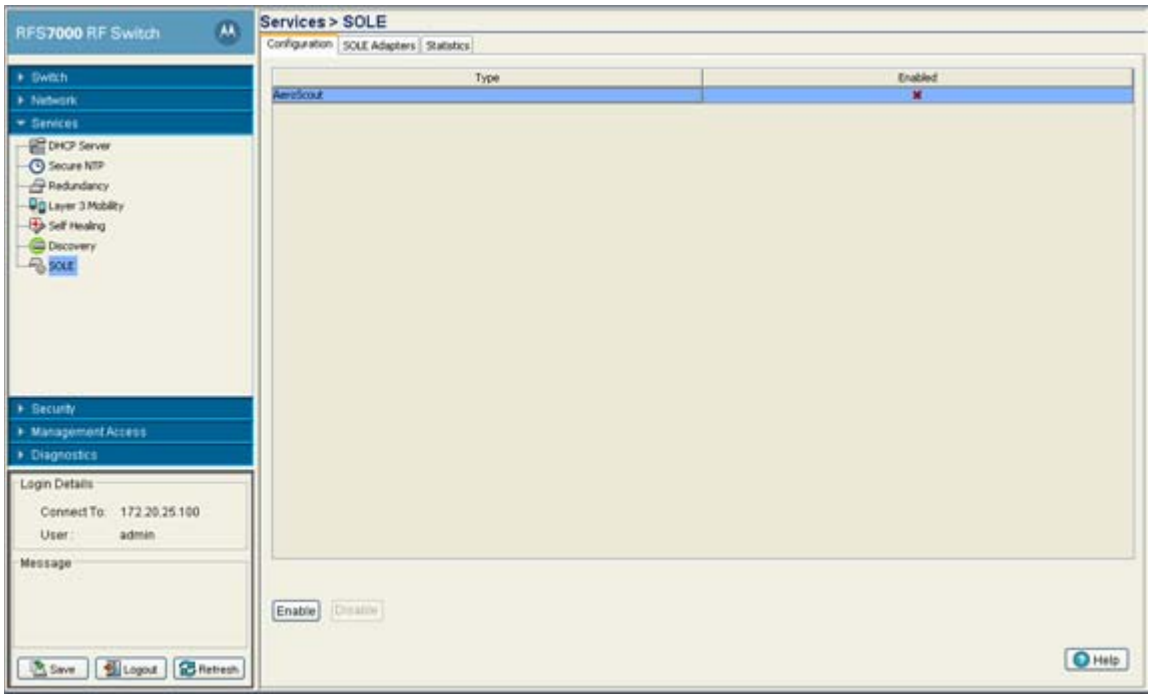
- *Defining the SOLE Configuration*
- *Viewing SOLE Adapters*
- *Reviewing SOLE Statistics*

5.8.1 Defining the SOLE Configuration

To define the SOLE configuration:

1. Select **Services** > **SOLE** from the main menu tree.

   The Configuration tab displays the adapters available to the switch.



Type	Displays the configuration for those SOLE adapters detected. Currently, the switch supports Aeroscout adapters.
Enabled	This columns displays a green checkmark for each SOLE adapter enabled, and a red X for each that is disabled.

2. Click the **Enable** button to enable a selected SOLE adapter currently disabled.

The **Enabled** column displays a green checkmark next to the SOLE adapter once enabled. A Red X defines the adapter as disabled.

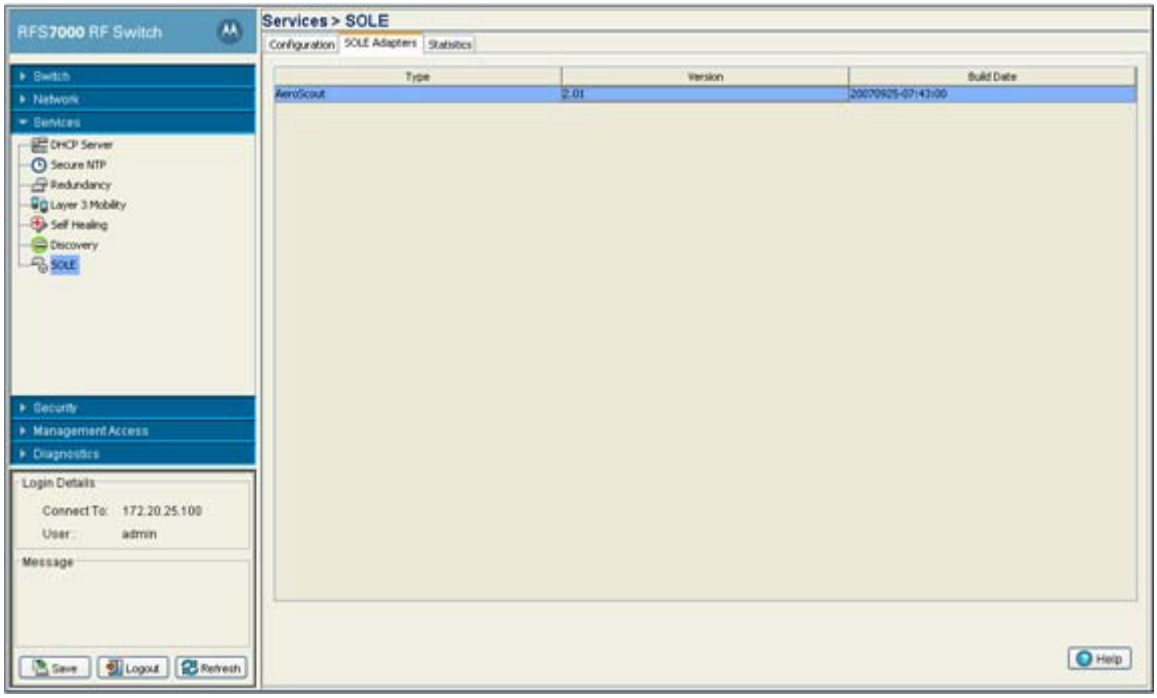
NOTE In order to set the listening MAC in each radio you must use the radio command in the switch's Command Line Interface (CLI). An example of the command syntax is:. ***#radio <1-n> tag-type aeroscout listen-addr 01-0c-cc-00-00-00***

3. Click the **Disable** button to disable a selected SOLE adapter. The Enable column displays a red X next to the SOLE adapter once disabled.

5.8.2 Viewing SOLE Adapters

Periodically review the SOLE Adapters tab to assess the adapters available to the switch. To review available SOLE adapters:

1. Select **Services** > **SOLE** from the main menu tree.
2. Select the **SOLE Adapters** tab.



3. Review the following to ascertain the SOLE adapters seen by the switch:

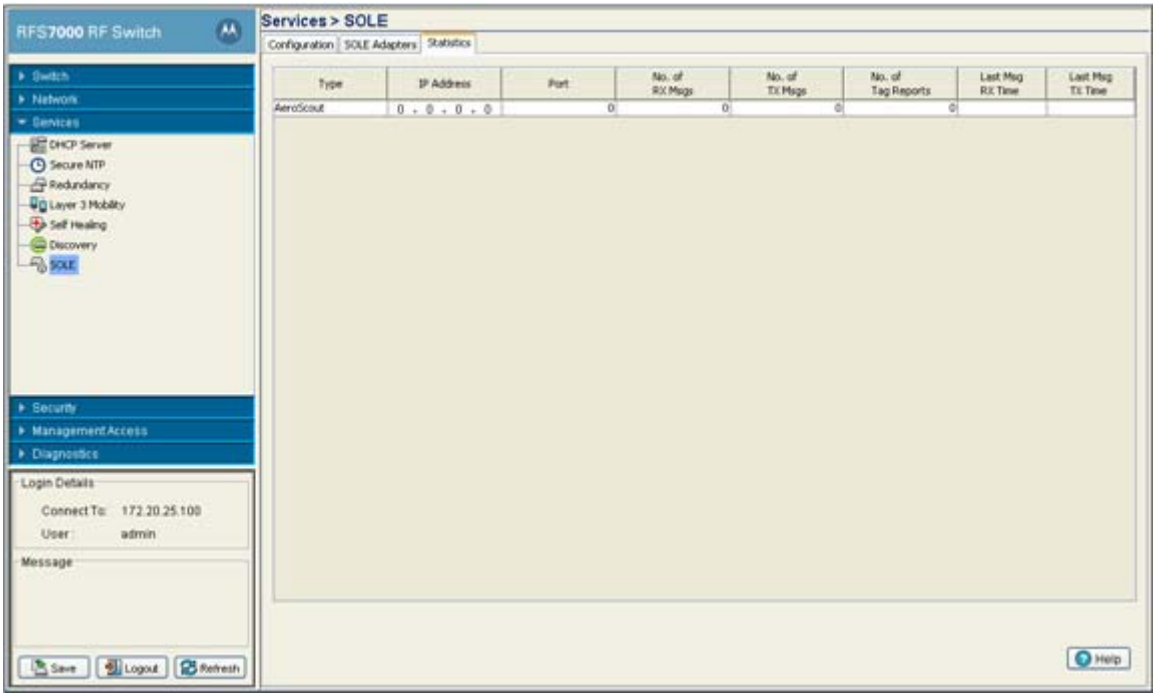
Type	Displays the configuration type for each SOLE adapter. Currently, the only supported type is Aeroscout.
Version	Displays the version number of the SOLE adapter.
Build Date	Displays the SOLE adapter build date and time.

5.8.3 Reviewing SOLE Statistics

Periodically review SOLE statistics to determine the extent of the message traffic transmitted and received over the SOLE adapter.

To review SOLE statistics:

1. Select **Services** > **SOLE** from the main menu tree.
2. Select the **Statistics** tab.



3. Review the following information within the Statistics tab:

Type	Displays the configuration type for each SOLE adapter. Currently the only supported type is Aeroscout.
IP Address	Displays the IP Address for the SOLE adapter.
No. of RX Messages	Displays the number of recieved message packets received on SOLE adapter.
No. of TX Messages	Displays the number of transmitted message packets sent on the SOLE adapter.
No. of Tag Reports	Displays the number of locationing tag reports received on the SOLE adapter.
Last Msg RX Time	Displays the time stamp of the last message received on the SOLE adapter.
Last Msg TX Time	Displays the time stamp of the last message transmitted on the SOLE adapter.

6

Switch Security

This chapter describes the security mechanisms available to the switch. This chapter describes the following security configuration activities:

- *Displaying the Main Security Interface*
- *AP Intrusion Detection*
- *MU Intrusion Detection*
- *Configuring Wireless Filters*
- *ACL Configuration*
- *Configuring NAT Information*
- *Configuring IKE Settings*
- *Configuring IPSec VPN*
- *Configuring the Radius Server*
- *Creating Server Certificates*
- *Configuring Enhanced Beacons and Probes*

NOTE HTTPS must be enabled to access the switch applet. Ensure HTTPS access has been enabled before using the login screen to access the switch applet.

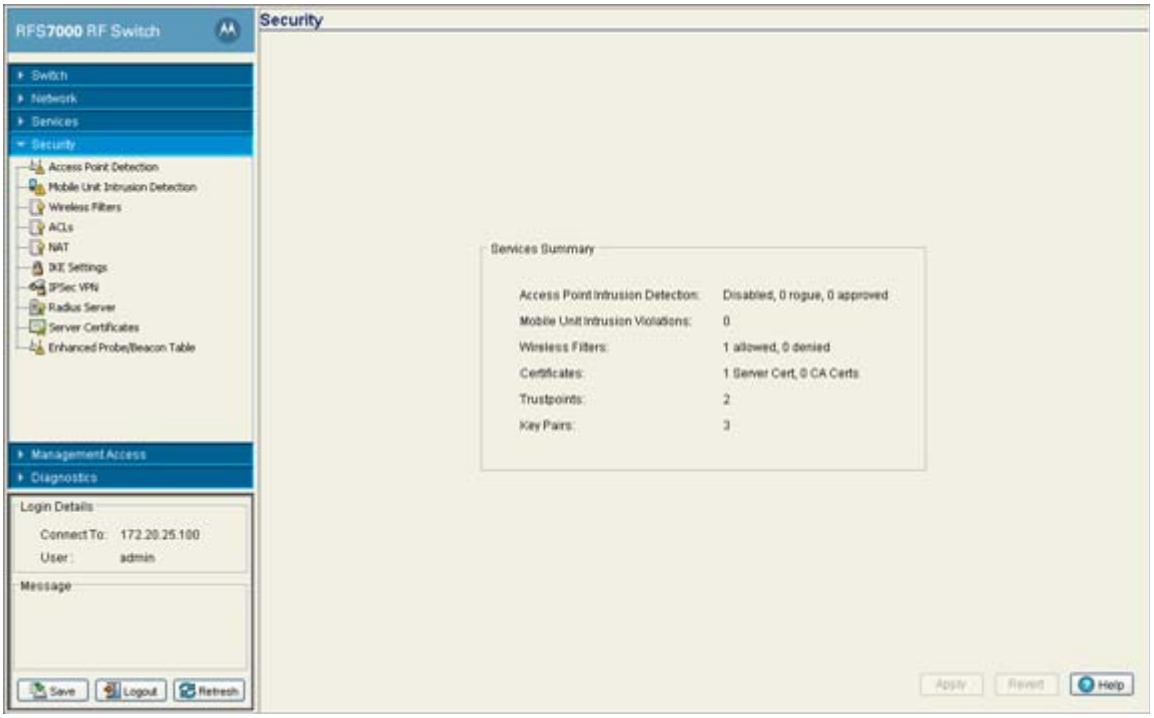
6.1 Displaying the Main Security Interface

Refer to main **Security** interface for a high level overview of device intrusion and switch access permission options.

NOTE When the switch's configuration is successfully updated (using the Web UI), the effected screen is closed without informing the user their change was successful. However, if an error were to occur, the error displays within the effected screen's Status field and the screen remains displayed. In the case of file transfer operations, the transfer screen remains open during the transfer operation and remains open upon completion (with status displayed within the Status field).

To view main menu security information:

1. Select **Security** from the main menu tree.



2. Refer to the following information to discern if configuration changes are warranted:

Access Port Intrusion Detection	Displays the Enabled or Disabled state of the switch to detect potentially hostile access ports (the definition of which defined by you). Once detected, these devices can be added to a list of devices either approved or denied from interoperating within the switch managed network. For more information, see *AP Intrusion Detection on page 6-4*.
Mobile Unit Intrusion Violations	Displays the state of the switch protecting against threats from MUs trying to find network vulnerabilities. For more information, see *MU Intrusion Detection on page 6-10*.
Wireless Filters	Displays the state of the current filters used to either allow or deny a MAC address (or groups of MAC addresses) from associating with the switch. For more information, see *Configuring Wireless Filters on page 6-14*.
Certificates	Displays the number of Server and CA certificates currently in use by this switch. For more information, see *Creating Server Certificates on page 6-86*
Trustpoints	Displays the number of trustpoints currently in use by this switch. The trustpoint signing the certificate can be a certificate authority, corporation or an individual. A trustpoint represents a CA/identity pair and contains the identity of the CA, CA-specific configuration parameters, and an association with one enrolled identity certificate. For more information, see *Using Trustpoints to Configure Certificates on page 6-86*.
Key Pairs	Displays the number of key pairs currently in use by this switch. For more information, see *Configuring Trustpoint Associated Keys on page 6-94*.

The **Apply** and **Revert** buttons are greyed out within this screen, as there is no data to be configured or saved.

6.2 AP Intrusion Detection

Use the **Access Point Detection** menu options to view and configure network related IP information. The Access Point Detection screen consists of the following tabs:

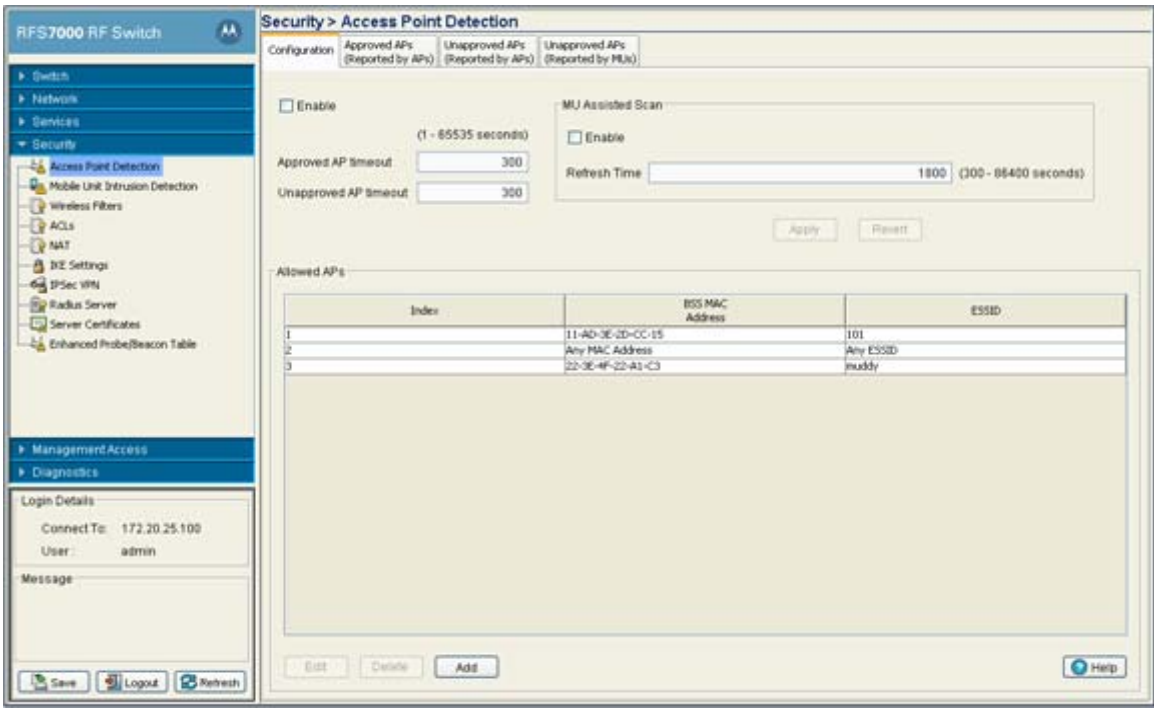
- *Enabling and Configuring AP Detection*
- *Approved APs (Reported by APs)*
- *Unapproved APs (Reported by APs)*
- *Unapproved APs (Reported by MUs)*

6.2.1 Enabling and Configuring AP Detection

Use the **Configuration** screen to allow the switch to detect potentially hostile access points, set the number of detected APs allowed and define the timeout and threshold values used for detection. The switch can enable both access ports and MUs to scan and detect access points within the switch managed network. Continually re-validating the credentials of associated devices reduces the possibility of an access point hacking into the switch managed network.

To configure AP Detection:

1. Select **Security** > **Access Port Intrusion Detection** from the main menu.
2. Select the **Configuration** tab.



3. Enable AP assisted scanning and timeout intervals as required.

Enable	Select the **Enable** checkbox to enable associated access ports to detect potentially hostile access points (the definition of which defined by you). Once detected, the access points can be added to a list of APs either approved or denied from interoperating within the switch managed network.

Approved AP timeout	Define a value (in seconds) the switch uses to timeout (previously approved) access points that have not communicated with the switch. The range is from 1-65535 seconds, with a default of 300 seconds. This value is helpful for continually re-validating access points that interoperate within the switch managed network.
Unapproved AP timeout	Define a value (in seconds) the switch uses to remove access points that have not communicated with the switch. The range is from 1-65535 seconds, with a default of 300 seconds.

4. Refer to the **MU Assisted Scan** field to enable associated MUs to assist in the detection of access points.

Enable	Select the **Enable** checkbox to enable associated MUs to detect potentially hostile access points (the definition of which defined by you). Once detected, these devices can be added to a list of access points either approved or denied from interoperating within the switch managed network.
Refresh Time	Define a value (in seconds) associated MUs use to scan for access points within the switch managed network. The range is from 300 - 86400 seconds, with a default of 1800 seconds.

5. Click the **Apply** button to save the changes made.
6. Click the **Revert** button to cancel any changes and revert back to the last saved configuration.
7. Refer to the **Allowed APs** field to view the policies used for interpreting allowed access points within the switch managed network.

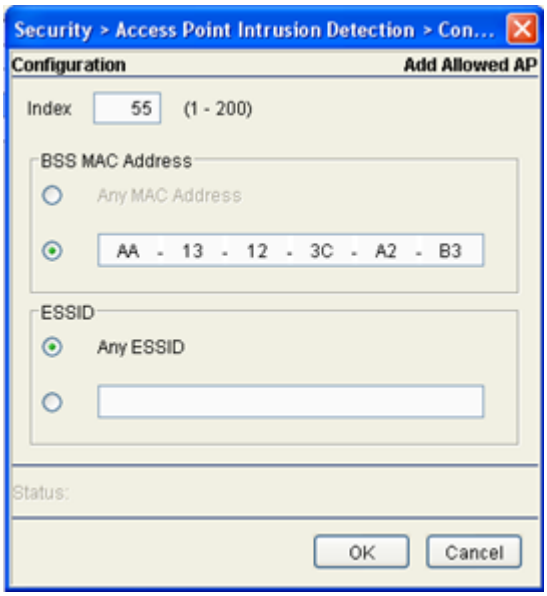
Index	Displays the numerical identifier (index value) assigned to this particular set of Allowed APs. Assign this value by clicking **Add** for a new set of access point address information or click the **Edit** button to revise the index. The Index can be used as reference to group specific devices numerically to a specific range of MAC or ESSID addresses. This user cannot modify the index from this screen.
BSS MAC Address	Displays the MAC address of the Allowed AP(s). The MAC addresses displayed are defined by clicking the **Add** button and entering a specific MAC address or by allowing all MAC addresses to be allowed. The list of MAC addresses allowed can be modified by highlighting an existing entry, clicking the **Edit** button and revising the properties of the MAC address.
ESSID	Displays the ESSIDs of the Allowed AP(s). The addresses displayed are defined by clicking the **Add** button and entering a specific MAC address or by allowing all MAC addresses to be allowed. The list of MAC addresses allowed can be modified by highlighting an existing entry, clicking the **Edit** button and revising the properties of the MAC address.

8. Select an Allowed AP and click the **Edit** button to launch a screen used to modify the index and SSID of the AP. For more information, see *Adding or Editing an Allowed AP on page 6-6*.
9. Select an Allowed AP and click the **Delete** button to remove the AP from list of Allowed APs.
10. Click the **Add** button to display a screen used to enter device information for a new AP added to the Allowed AP list. For more information, see *Adding or Editing an Allowed AP on page 6-6*.

6.2.1.1 Adding or Editing an Allowed AP

To add a new range or modify the address range used to designate devices as Allowed APs:

1. Select **Security** > **Access Point Intrusion Detection** from the main tree menu.
2. Click the **Configuration** tab.
3. Select an existing Allowed AP and click the **Edit** button to modify the properties of an existing Allowed AP or click the **Add** button to define the attributes of a new Allowed AP.



4. If adding a new Allowed AP, use the **Index** parameter to assign a numerical index value to this particular access point. The index range is from 1-200. If editing an existing Allowed AP, this is a read only field and cannot be modified.
5. Refer to the **BSS MAC Address** field to define the following:

Any MAC Address/ Specific MAC Address	Click the **Any MAC Address** radio button to allow any MAC address detected on the network as an Allowed AP. This is not necessary if a specific MAC address is used with this index. Click the second radio button to enter a specific MAC address as an Allowed AP. Use this option if (for network security) you want to restrict the number of MAC Addresses to a single MAC address.

6. Refer to the **ESSID** field to configure access point ESSID permissions.

Any ESSID/Specific ESSID	Click the **Any ESSID** radio button to allow any ESSID located on the network as an Allowed AP. This may not be necessary if a specific ESSID was used with this particular index. Click the second radio button to enter a specific ESSID as an Allowed AP. Use this option if (for network security) you want to restrict the number of device ESSIDs saved for this index to a single access point ESSID.

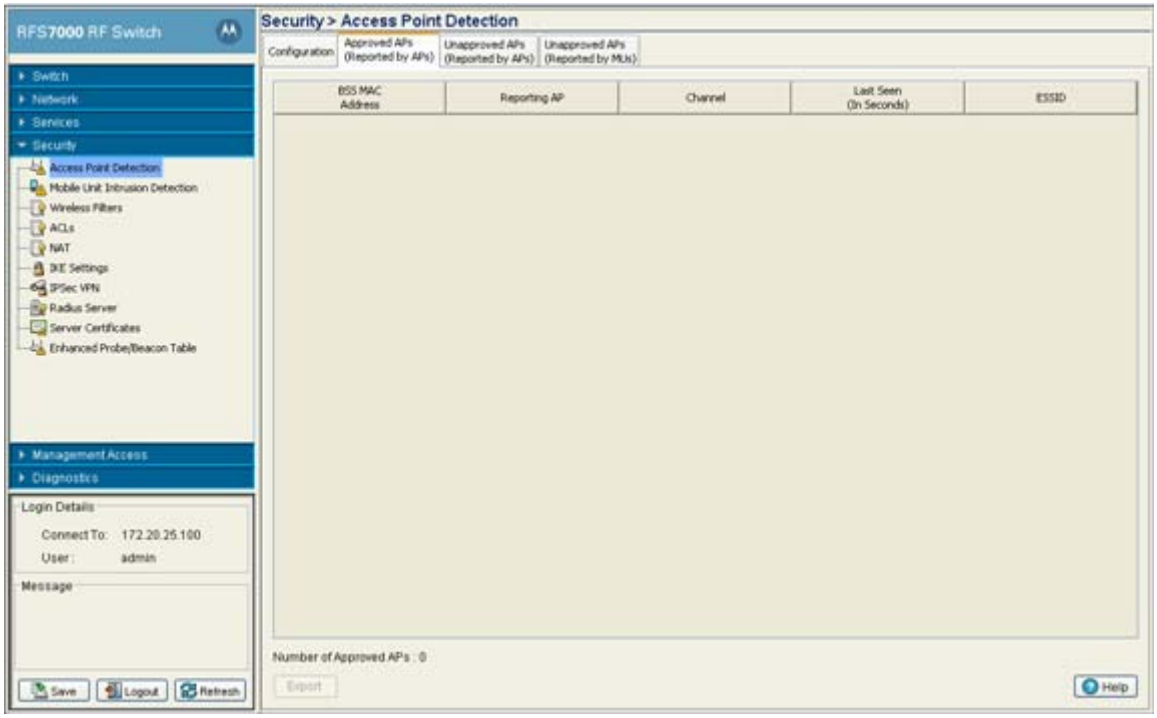
7. Refer to the **Status** field for the current state of the requests made from applet. This field displays error messages if something goes wrong in the transaction between the applet and the switch.
8. Click **OK** to use the changes to the running configuration and close the dialog.
9. Click **Cancel** to close the dialog without committing updates to the running configuration.

6.2.2 Approved APs (Reported by APs)

Those access points detected and approved for operation within the switch managed network can be separately displayed to assess the reporting (detecting) AP, the channel of operation, the last time the AP was observed on the network and the ESSID. Use this information to assess if an approved access point was incorrectly defined as approved and requires categorization as an unapproved and disallowed AP.

To review the attributes of allowed APs:

1. Select **Security** > **Access Port Intrusion Detection** from the main menu.
2. Select the **Approved APs (Reported by APs)** tab.



3. The **Approved APs (Reported by APs)** table displays the following information:

BSS MAC Address	Displays the MAC Address of each approved AP. These MAC addresses are access points observed on the network meeting the criteria (MAC and ESSIDs) of allowed APs.
Reporting AP	Displays the numerical value for the radio used with the specific device MAC Address and SSID listed for this approved AP.
Channel	Displays the channel the approved AP is currently transmitting on. If this device is operating on a channel not frequently used within your network segment, perhaps the device is correctly defined as an approved AP.
Last Seen (In Seconds)	Displays the time (in seconds) the approved AP was last seen on the network.
ESSID	Displays the SSID of each approved AP.

4. The **Number of Approved APs** is simply the sum of all of approved access point MAC Addresses detected.

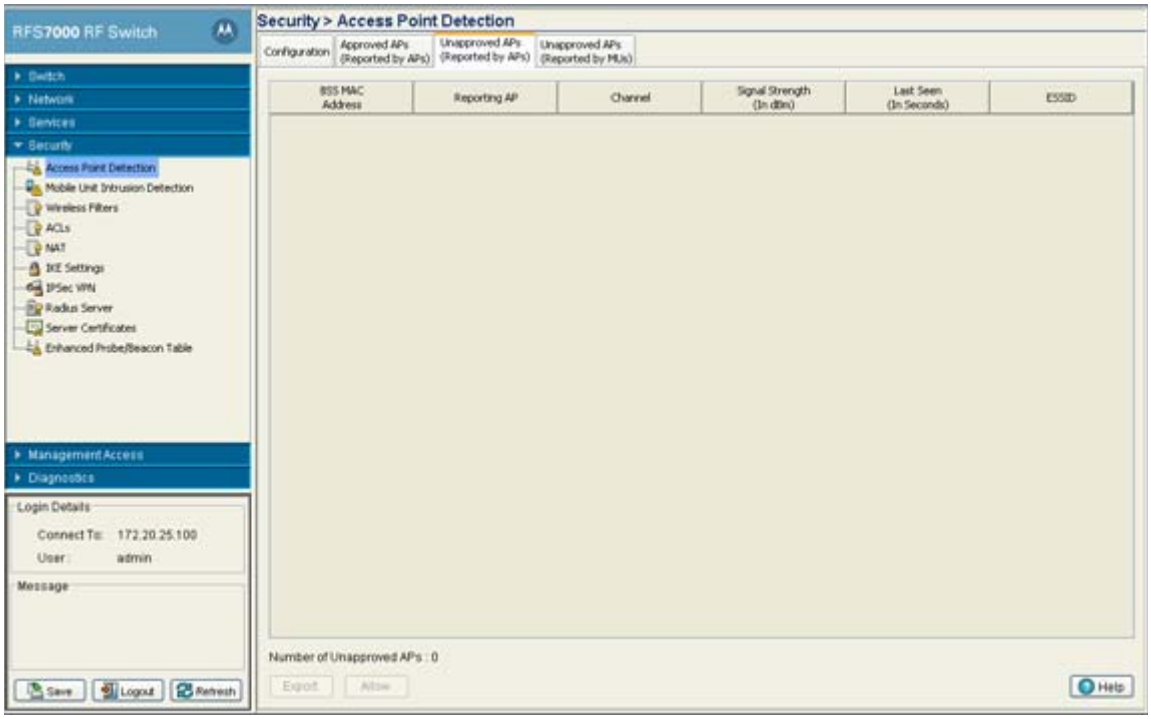
5. Click on the **Export** button to export the contents of the table to a *Comma Separated Values* file (CSV).

6.2.3 Unapproved APs (Reported by APs)

Use the **Unapproved APs (Reported by APs)** tab to review access points detected by associated switch access port radios and are restricted from operation within the switch managed network. The criteria for restriction was defined using the **Security** > **Access Port Intrusion Detection** > **Configuration** screen.

To view access port detected unapproved access points:

1. Select **Security** > **Access Port Intrusion Detection** from the main menu tree.
2. Click on the **Unapproved APs (Reported by APs)** tab.



3. The **Unapproved APs (Reported by APs)** table displays the following information:

BSS MAC Address	Displays the MAC Address of each Unapproved AP. These MAC addresses are access points observed on the network, but have yet to be added to the list of Approved APs, and are therefore interpreted as a threat on the network. If a MAC Address displays on the list incorrectly, click the **Allow** button and add the MAC Address to a new Allowed AP index.
Reporting AP	Displays the numerical value for the radio used with the detecting AP.
Channel	Displays the channel the Unapproved AP is currently transmitting on.
Signal Strength (in dbm)	Displays the *Relative Signal Strength Indicator* (RSSI) for the detected (and unapproved) AP. AP's with a strong signal may pose a more significant risk within the switch managed network.

Last Seen (In Seconds)	Displays the time (in seconds) the Unapproved AP was last seen on the network by the detecting AP.
ESSID	Displays the ESSID of each Unapproved AP. These ESSIDs are device ESSIDs observed on the network, but have yet to be added to the list of Approved APs and are therefore interpreted as a threat. If an ESSID displays on the list incorrectly, click the **Allow** button and add the ESSID to a new Allowed AP index.

4. The **Number of Unapproved APs** is simply the sum of all of Unapproved Radio MAC Addresses detected.
5. If a Radio MAC address is listed incorrectly, highlight the Radio MAC Address and click the **Allow** button.

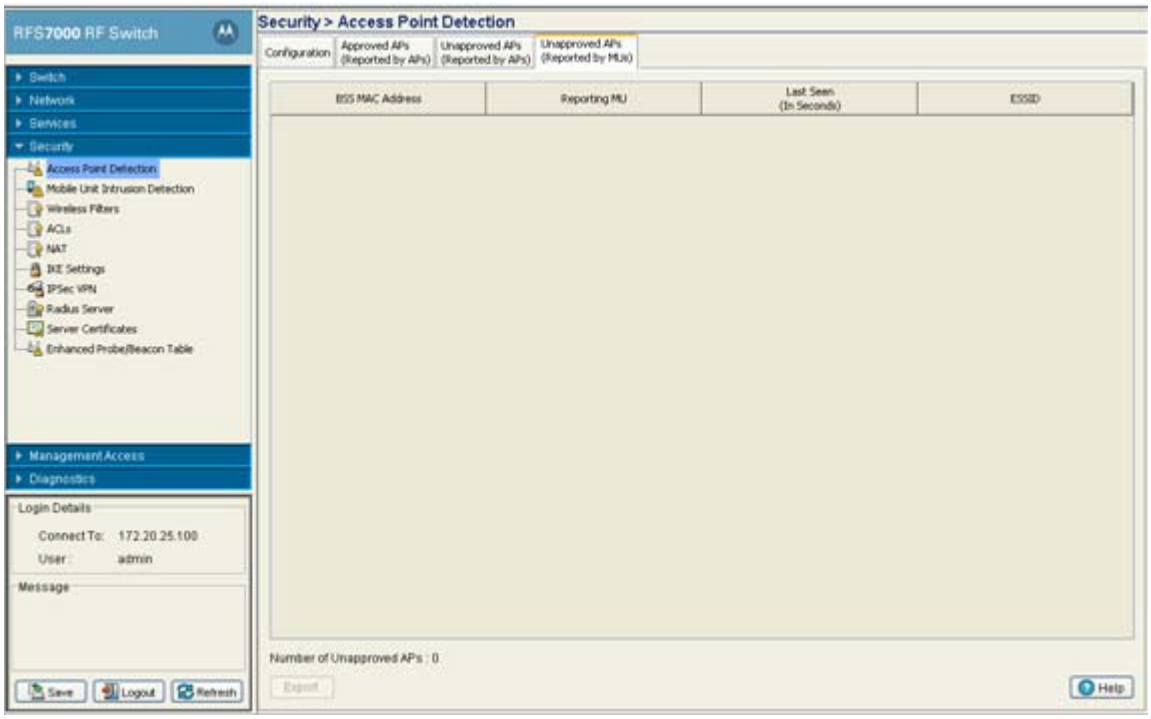
   Assign an Index and complete the required device address information to move the device into the list of approved access point MAC addresses. The number of Unapproved APs updates accordingly as devices are added and removed.
6. Click the **Export** button to export the contents of the table to a *Comma Separated Values* file (CSV).

6.2.4 Unapproved APs (Reported by MUs)

Use the **Unapproved APs (Reported by MUs)** tab to review unapproved access points detected by associated MUs. The criteria for access point approval was defined using the **Security** > **Access Port Intrusion Detection** > **Configuration** screen, using the values defined within the **MU Assisted Scan** field.

To view MU detected unapproved access points:

1. Select **Security** > **Access Port Detection** from the main menu tree.
2. Click on the **Unapproved APs (Reported by MUs)** tab.



3. The **Unapproved APs (Reported by MUs)** table displays the following information:

BSS MAC Address	Displays the MAC Address of each Unapproved AP. These MAC addresses are access points observed on the network (by associated MUs), but have yet to be added to the list of approved APs, and are therefore interpreted as a threat on the network.
Reporting MU	Displays the numerical value for the detecting MU.
Last Seen (In Seconds)	Displays the time (in seconds) the Unapproved AP was last seen on the network by the detecting MU.
ESSID	Displays the ESSID of each Unapproved AP. These ESSIDs are device ESSIDs observed on the network, but have yet to be added to the list of Approved APs and are therefore interpreted as a threat.

4. The **Number of Unapproved APs** is simply the sum of all of Unapproved Radio MAC Addresses detected.
5. Click the **Export** button to export the contents of the table to a *Comma Separated Values* file (CSV).

6.3 MU Intrusion Detection

Unauthorized attempts to access the switch managed LAN by MUs is a significant threat to the network, and one that is very pervasive currently. The switch has several means to protect against threats from MUs trying to find network vulnerabilities.

Use the switch's **Mobile Unit Intrusion Detection** facility to view and configure MU intrusion related information. The Mobile Unit Intrusion Detection screen provides the following functionalities:

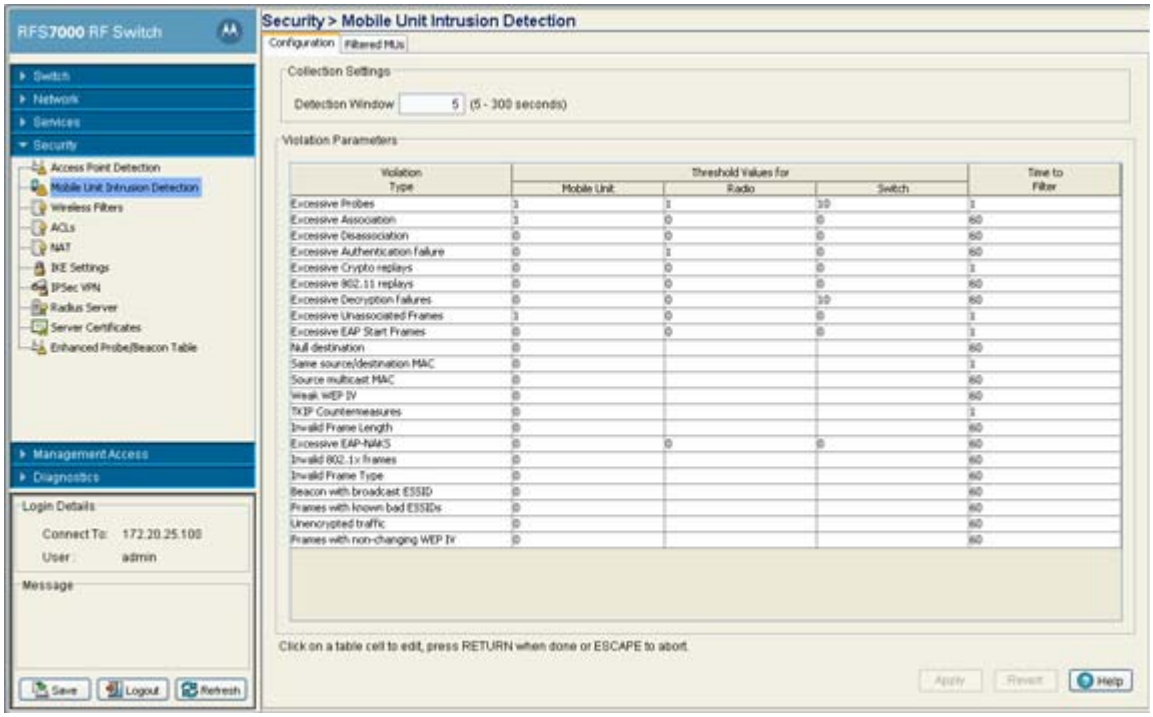
- *Configuring MU Intrusion Detection*
- *Viewing Filtered MUs*

6.3.1 Configuring MU Intrusion Detection

To configure MU intrusion detection:

1. Select **Security** > **Mobile Unit Intrusion Detection** from the main tree menu.

2. Click the **Configuration** tab.



3. Within the **Collection Settings** field, set the **Detection Window** interval (in seconds) the switch uses to scan for MU violations. The available range is from 5 - 300 seconds with a default value of 5 seconds.
4. Refer to the **Violation Parameters** field to define threshold values that trigger an alarm:

Violation Type	Displays the name of the violation for which threshold values are set in the MU, radio and switch columns.
Mobile Unit	Set the MU threshold value for each violation type. If exceeded, the MU will be filtered and displayed within the Filtered MUs screen. Set the values appropriately in respect to the number of MUs within the switch managed network and how often they are associating/disassociating, and have their authentication and encryption credentials verified.
Radio	Set the radio threshold value for each violation type. If exceeded, the MU is filtered and displayed within the Filtered MUs screen.
Switch	Set the switch's threshold value for each violation type. If exceeded, the offending MU is filtered (from the switch) and displayed within the Filtered MUs screen.
Time to Filter	Set the Time to Filter interval (in seconds) the switch uses to filter out MUs defined as committing a violation. Refer to *Viewing Filtered MUs on page 6-12* to review the contents of the MUs filtered thus far.

CAUTION Setting MU threshold values too low can jeopardize MU performance or break the MU's connection.

5. When using the **Frames with known bad ESSIDs** violation parameter it is necessary to enter a list of known bad ESSIDs for the violation parameter. To enter this information, select **Frames with known bad ESSIDs** and then click the **Bad Essid Config** button to launch a dialogue box where bad ESSIDs can be added and removed.

NOTE If using the **Frames with known bad ESSIDs** violation parameter if no ESSIDs are entered in the **Bad Essid Config** dialogue, this parameter will not function.

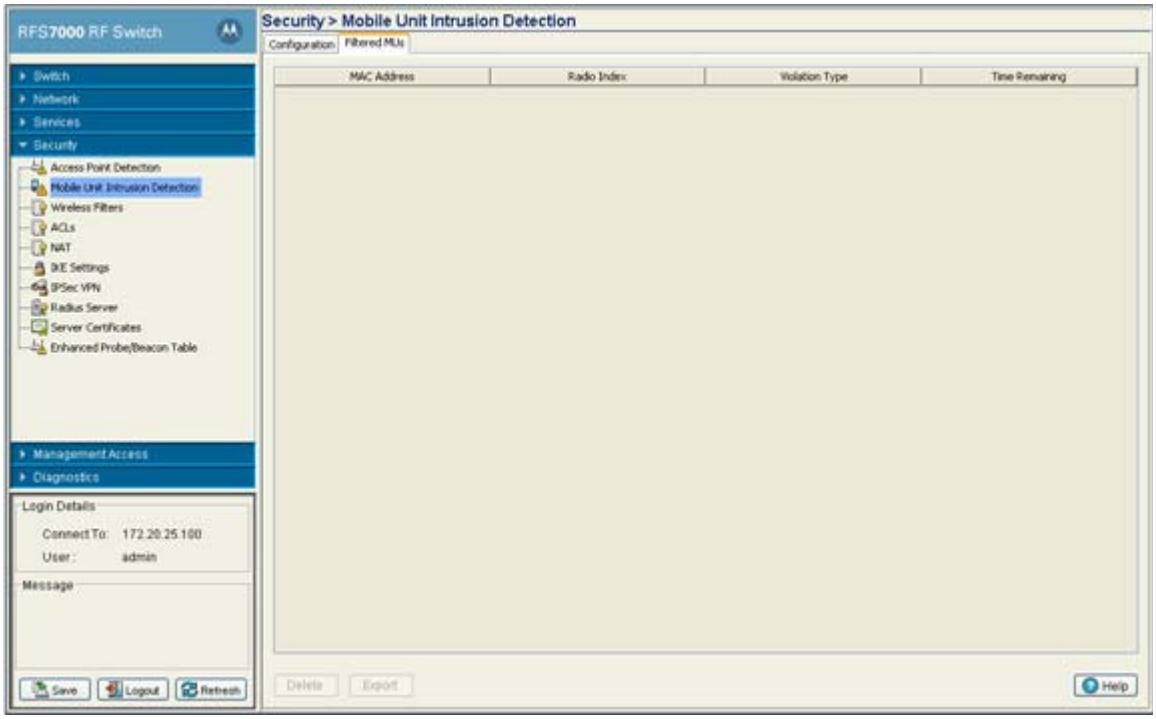
6. Click on **Apply** button to save the configuration.
7. Click on **Revert** to rollback to the previous configuration.

6.3.2 Viewing Filtered MUs

Periodically check the **Filtered MUs** tab to review those MUs filtered by the switch for incurring a violation based on the settings defined within the **Configuration** tab. Each MU listed can be deleted from the list or its attributes exported to a user defined location.

To view status of those MUs filtered using the settings defined within the **Configuration** tab:

1. Select **Security** > **Mobile Unit Intrusion Detection** from the main tree menu.
2. Select the **Filtered MUs** tab.



The Filtered MUs tab displays the following read-only information for detected MUs:

MAC Address	Displays the MU's MAC address. Refer to this address as the potentially hostile MU's identifier.
Radio Index	The Radio Index displays the index of the radio detecting the MU violation. Use this information to discern whether the detected MU is known and whether it truly constitutes a threat.

Violation Type — Displays the reason the violation occurred for each detected MU. Use the Violation Type to discern whether the detected MU is truly a threat on the switch managed network (and must be removed) or can be interpreted as a non threat. The following violation types are possible:

- *Excessive Probes*
- *Excessive Association*
- *Excessive Disassociation*
- *Excessive Authentication failure*
- *Excessive Crypto replays*
- *Excessive 802.11 replays*
- *Excessive Decryption failures*
- *Excessive Unassociated Frames*
- *Excessive EAP Start Frames*
- *Null destination*
- *Same source/destination MAC*
- *Source multicast MAC*
- *Weak WEP IV*
- *TKIP Countermeasures*
- *Invalid Frame Length*
- *Excessive EAP-NAKS*
- *Invalid 802.1x frames*
- *Invalid Frame Type*
- *Beacon with broadcast ESSID*
- *Frames with known bad ESSIDs*
- *Unencrypted traffic*
- *Frames with non-changing WEP IV*

NOTE: The following violation types require the access port be in scan mode:

- *Beacon with broadcast ESSID*
- *Frames with known bad ESSIDs*

Time Remaining — Displays the time remaining before the next filter activity. Detected MUs are removed from the filtered list when they no longer violate the thresholds defined within the Configuration tab.

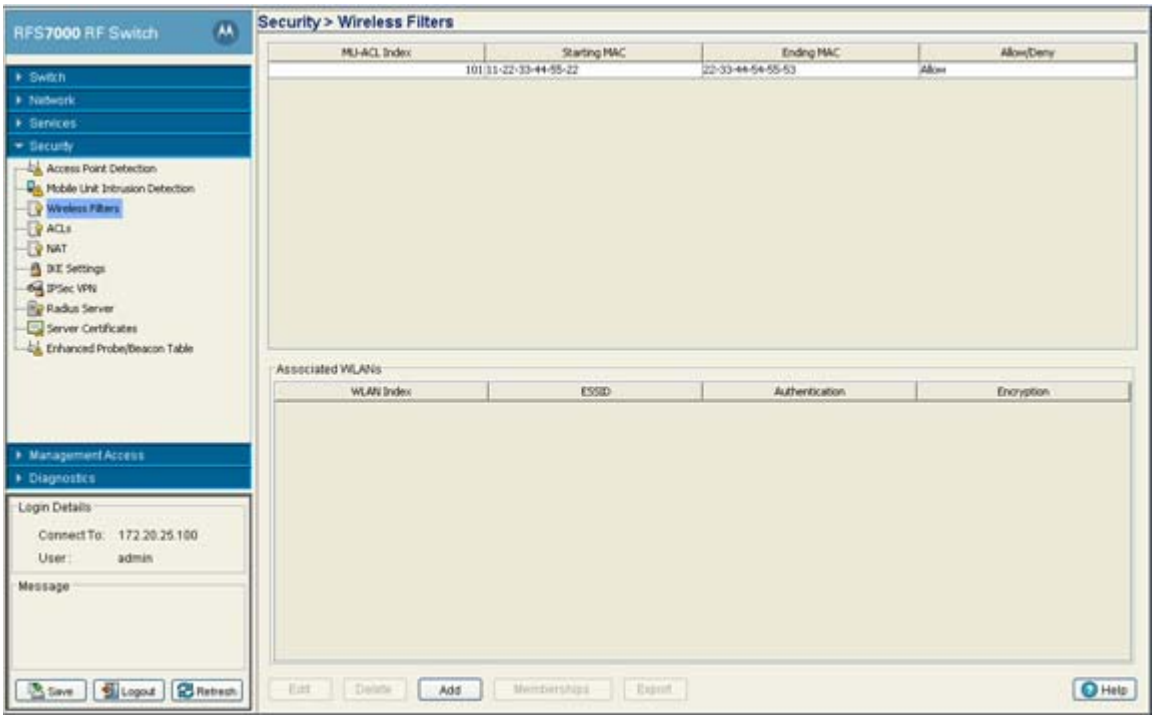
3. Select a detected MU and click the **Delete** button to remove it from the list of MUs you are tracking as potential threats within the switch managed network.
4. Click on the **Export** button to export the contents of the table to a *Comma Separated Values* file (CSV).

6.4 Configuring Wireless Filters

Use filters to either allow or deny a MAC address (or groups of MAC addresses) from associating with the switch. Refer to the **Wireless Filters** screen to review the properties of existing switch filters. A filter can be selected from those available and edited or deleted. Additionally, a new filter can be added if an existing filter does not adequately express the MU's address range required.

To display the Wireless Filters main page:

1. Select **Security > Wireless Filters** from the main menu tree.
2. The **Wireless Filters** tab is divided into 2 fields:
   - *Filters*
   - *Associated WLANs*



The **Filters** field contains the following read-only information:

MU-ACL Index	Displays a numerical identifier used to associate a particular ACL to a range of MAC addresses (or a single MAC address) either allowed or denied access to the switch managed network.
Starting MAC	Displays the beginning MAC Address (for this specific Index) either allowed or denied access to the switch managed network.
Ending MAC	Displays the ending MAC Address (for this specific Index) either allowed or denied access to the switch managed network.
Allow/Deny	States whether this particular ACL Index and MAC address range has been allowed or denied access to the switch managed network.

3. Refer to the **Associated WLANs** field for following

WLAN Index	Highlight an Index to display the name(s) of the WLANs currently associated with this particular Index. Click the **Membership** button to map available WLANs to this filter.
ESSID	Displays the SSID required by the devices comprising this WLAN.
Authentication	Displays the authentication scheme configured for the devices comprising this WLAN.
Encryption	Displays the encryption method configured for the devices comprising this WLAN.

4. If the properties of an existing filter are close to your needs but still require modification to better filter devices, select the **Edit** button. For more information see, *Editing an Existing Wireless Filter on page 6-15*.
5. If an existing filter is now obsolete, select it from those listed and click the **Delete** button.
6. Click the **Add** button to create a new filter. For more information, see *Adding a new Wireless Filter on page 6-16*.
7. Click the **Memberships** button to display a screen wherein a selected index can be added to one or more existing WLANs. For more information see, *Associating an ACL with WLAN on page 6-17*
8. Click on the **Export** button to export the contents of the table to a *Comma Separated Values* file (CSV).

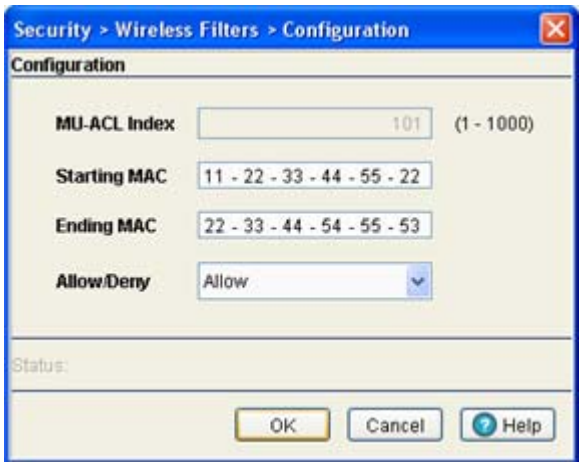
6.4.1 Editing an Existing Wireless Filter

Use the **Edit** screen to modify the properties of an existing filter. This is recommended if an existing filter contains adequate device address information, but the allow/deny permissions need to be changed or if only minor changes are required to the starting and ending MAC addresses. If significant changes are required to a usable filter, consider creating a new one.

To edit an existing filter:

1. Select **Special Features** > **Filters** from the main menu tree.
2. Select one of the existing ACLs from the filters list.
3. Click the **Edit** button at the bottom of the screen to launch a screen for editing an ACL.

The user can modify an ACL Index (numerical identifier) for the ACL, and edit the starting an ending MAC address range for the devices allowed or denied access to the switch managed network.



4. The **MU-ACL Index** is used as an identifier for a MAC Address range and allow/deny ACL designation. The available index range is 1 - 1000. However, the index is not editable, only its starting/ending MAC range and allow/deny designation. If a new index is needed, create a new filter.
5. Modify the existing **Starting MAC** for the target Index or leave the **Starting MAC** value as is and just modify the **Ending MAC** Address or **Allow**/**Deny** designation.
6. Modify the existing **Ending MAC** for the target Index. Enter the same Starting MAC address within the **Ending MAC** field to use only the **Starting MAC** address as either allowed or denied access to the switch managed network.
7. Use the drop-down menu to select **Allow** or **Deny**.

   This rule applies to the MUs within the specified Starting and Ending MAC Address range. For example, if the adoption rule is to Allow, access is granted for all MUs within the specified range.
8. Refer to the **Status** field for the current state of the requests made from applet. This field displays error messages if something goes wrong in the transaction between the applet and the switch.
9. Click **OK** to use the changes to the running configuration and close the dialog.
10. Click **Cancel** to close the dialog without committing updates to the running configuration.

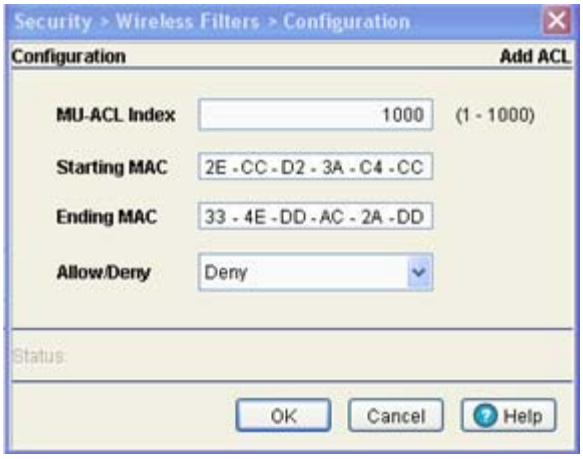
6.4.2 Adding a new Wireless Filter

Use the **Add** screen to create a new index and define a new address permission range. Once created, an allow or deny designation can be applied to the new filter ACL.

To create a new filter ACL:

1. Select **Security > Wireless Filters** from the main menu tree.
2. Click the **Add** button at the bottom of the screen to launch a new dialogue used for creating an ACL.

Define an Index (numerical identifier) for the ACL and the starting and ending MAC address range for devices allowed/denied access to the switch managed network.



3. Enter an Index numerical value (1 -1000) in the **MU-ACL Index** field.

   The MU-ACL Index is a numerical identifier used to associate a particular ACL to a range of MAC addresses (or a single MAC address) either allowed or denied access to the switch managed network. Enter a new Index to define a new MAC Address range and allow/deny ACL Index designation.

4. Enter the a hex value for the **Starting MAC** address.

   This is the beginning MAC address either allowed or denied access to the switch managed network.

5. Enter the a hex value for the **Ending MAC** address. Enter the same Starting MAC address within the **Ending MAC** field to use only the **Starting MAC** address as either allowed or denied access to the switch managed network.

6. Use the drop-down menu to select **Allow** or **Deny**.

   This rule applies to the MUs within the specified Starting and Ending MAC Address range. For example, if the adoption rule is to Allow, access is granted for all MUs within the specified range.

7. Refer to the **Status** field for the current state of the requests made from applet. This field displays error messages if something goes wrong in the transaction between the applet and the switch.

8. Click **OK** to use the changes to the running configuration and close the dialog.

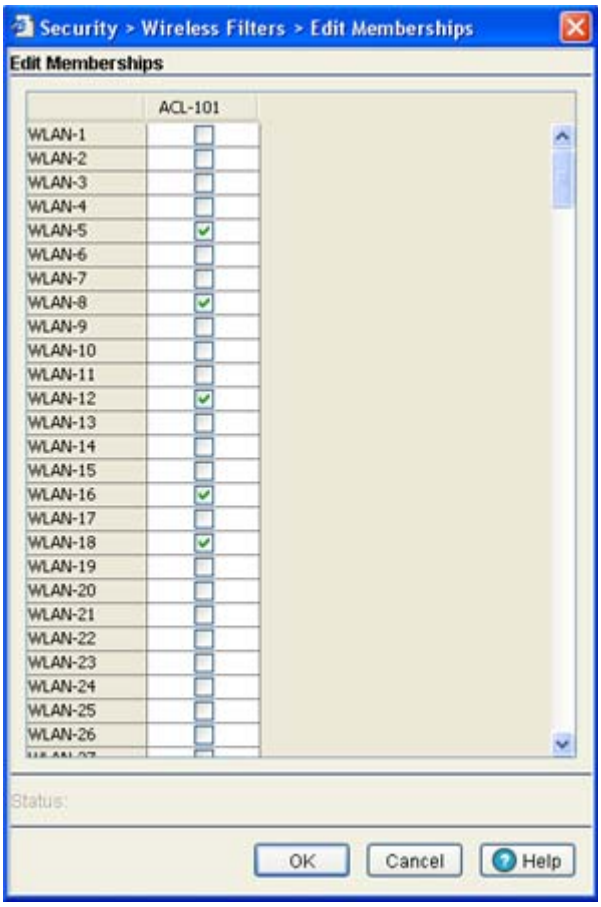
9. Click **Cancel** to close the dialog without committing updates to the running configuration.

6.4.3 Associating an ACL with WLAN

Use the **Membership** screen to define a name for the ACL index and map the index to WLANs (1-32) requiring membership permission restrictions.

To associate a filter ACL index with a WLAN:

1. Select **Security** > **Wireless Filters** from the main menu tree.
2. Select one or more existing ACLs from the filters list.
3. Click the **Memberships** button.



4. Select the box to the right of each WLAN you want associated with the ACL.

   Selecting a WLAN maps it the MAC address range and allow or deny designation assigned to it. Consequently, be sure you are not restricting MU traffic for a WLAN that requires those MAC addresses to interact with the switch.

5. Refer to the **Status** field for the current state of the requests made from applet. This field displays error messages if something goes wrong in the transaction between the applet and the switch.
6. Click **OK** to use the changes to the running configuration and close the dialog.
7. Click **Cancel** to close the dialog without committing updates to the running configuration.

6.5 ACL Configuration

An *Access Control List* (ACL) is a sequential collection of permit and deny conditions that apply to switch data packets. When a packet is received on an interface, the switch compares the fields in the packet against any applied ACLs to verify the packet has the required permissions to be forwarded, based on the criteria specified in the access lists.

NOTE If a packet does not meet any of the criteria specified in the ACL, then the packet is dropped.

Use the **ACL** screen to view, add and configure access control configurations. Typically, an ACL consists of series of entries called an *Access Control Entry* (ACE). Each ACE defines the access rights for a user in relationship to the switch. When access is attempted, the operating system uses the ACL to determine whether the user has switch access permissions. The ACL screen displays four tabs supporting the following ACL configuration activities:

- *Configuring an ACL*
- *Attaching an ACL L2/L3 Configuration*
- *Attaching an ACL on a WLAN Interface/Port*
- *Reviewing ACL Statistics*

NOTE For an overview of how the switch uses an ACL to filter permissions to the switch managed network, go to *ACL Overview on page 6-19*.

6.5.1 ACL Overview

An ACL contains an ordered list of *Access Control Entries* (ACEs). Each ACE specifies an action and a set of conditions that a packet must satisfy in order to match the ACE. The order of conditions in the list is critical because the switch stops testing conditions after the first match.

The switch supports the following ACLs to filter traffic:

- *Router ACLs*— Applied to VLAN (Layer 3) interfaces. These ACLs filter traffic based on Layer 3 parameters like *source IP, destination IP, protocol types* and *port numbers*. They are applied on packets routed through the switch. Router ACLs can be applied to inbound traffic only, not both directions.
- *Port ACLs*— Applied to traffic entering a Layer 2 interface. Only switched packets are subjected to these kind of ACLs. Traffic filtering is based on Layer 2 parameters like–*source MAC, destination MAC, Ethertype, VLAN-ID, 802.1p bits* (OR) Layer 3 parameters like– *source IP, destination IP, protocol, port number.*

NOTE ACLs can be applied only in an inbound direction. Only WLAN ACLs support applying ACLs in the outbound direction for both Layer 2 and Layer 3 interfaces.

- *Wireless LAN ACLs* - A Wireless LAN ACL is designed to filter/mark packets based on the wireless LAN from which they arrived rather than filtering the packets arrived on L2 ports. This type of ACL supports data in the outbound direction.

For more information, see:

- *Router ACLs*
- *Port ACLs*
- *Wireless LAN ACLs*
- *ACL Actions*

6.5.1.1 Router ACLs

Router ACLs are applied to Layer 3 or VLAN interfaces. If an ACL is already applied in a particular direction on an interface, applying a new one will replace the existing ACL. Router ACLs are applicable only if the switch acts as a gateway, and traffic is inbound only.

The switch supports two types of Router ACLs:

- *Standard IP ACL*—Uses the source IP address as matching criteria.
- *Extended IP ACL*—Uses the source IP address, destination IP address and IP protocol type as basic matching criteria. It can also include other parameters specific to a protocol type (like source and destination port for TCP/UDP protocols).

Router ACLs are *stateful* and are not applied on every packet routed through the switch. Whenever a packet is received from a Layer 3 interface, it is examined against existing sessions to determine if it belongs to an established session. ACLs are applied on the packet in the following manner.

1. If the packet matches an existing session, it is not matched against ACL rules and the session decides where to send the packet.
2. If no existing sessions match the packet, it is matched against ACL rules to determine whether to accept or reject it. If ACL rules accept the packet, a new session is created and all further packets belonging to that session are allowed. If ACL rules reject the packet, no session is established.

A session is computed based on:

- *Source IP address*
- *Destination IP address*
- *Source Port*
- *Destination Port*
- *ICMP identifier*
- *Incoming interface index*
- *IP Protocol*

Each session has a default idle time-out interval. If no packets are received within this interval, the session is terminated and a new session must be initiated. These intervals are fixed and cannot be configured by the user.

The default idle time-out intervals for different sessions are:

- *ICMP and UDP sessions*— 30 seconds
- *TCP sessions*— 2 hours

6.5.1.2 Port ACLs

The switch supports Port ACLs on physical interfaces and inbound traffic only. The following Port ACLs are supported:

- *Standard IP ACL*— Uses a source IP address as matching criteria.
- *Extended IP ACL*— Uses a source IP address, destination IP address and IP protocol type as basic matching criteria. It can also include other parameters specific to a protocol type, like the source and destination ports for TCP/UDP protocols.
- *MAC Extended ACL*— Uses source and destination MAC addresses and VLAN ID. It optionally, also uses Ethertype information.

Port ACLs are *not stateful* as compared to Router ACLs. Hence, it matches every packet against the configured ACL rules and takes action as defined by the ACL rules. When a Port ACL is applied to a trunk port, the ACL filters traffic on all VLANs present on the trunk port. With Port ACLs, you can filter:

- IP traffic by using IP ACL
- Non-IP traffic by using MAC addresses.

Both IP and non-IP traffic on the same Layer 2 interface can be filtered by applying both an IP ACL and a MAC ACL to the interface.

You cannot apply more than one IP ACL and one MAC ACL to a Layer 2 interface. If an IP ACL or MAC ACL is already configured on a Layer 2 interface and a new IP ACL or MAC ACL is applied to the interface, the new ACL replaces the previously configured one.

6.5.1.3 Wireless LAN ACLs

Wireless LAN ACLs filter/mark packets based on the wireless LAN from which they arrive rather than filtering the packets arrived on L2 ports.

In general, a Wireless-LAN ACL can be used to filter wireless to wireless, wireless to wired and wired to wireless traffic. Typical wired to wired traffic can be filtered using a L2 port based ACL rather than a WLAN ACL.

Each WLAN is assumed to be a virtual L2 port. Configure one IP and one MAC ACL on the virtual WLAN port. In contrast to L2 ACLs, a WLAN ACL can be enforced on both the Inbound and Outbound direction.

6.5.1.4 ACL Actions

Every ACE within an ACL is made up of an action and matching criteria. The action defines what to do with the packet if it matches the specified criteria. The following actions are supported:

- *deny*— Instructs the ACL not to allow a packet to proceed to its destination.
- *permit*—Instructs the ACL to allows a packet to proceed to its destination.
- *mark*—Modifies certain fields inside the packet and then permits them. Therefore, mark is an action with an implicit permit.
  - VLAN 802.1p priority.
  - TOS/DSCP bits in the IP header.

NOTE A Permit All ACL is not supported when using NTP. If a Permit All ACL is used with NTP, the client will not be able to synchronize with the NTP server.

NOTE Only a Port ACL supports a mark action. With Router ACLs, a mark is treated as a permit and the packet is allowed without modifications.

6.5.1.5 Precedence Order

The rules within an ACL are applied to packets based on their precedence values. Every rule has a unique precedence value between 1 and 5000. You cannot add two rules's with the same precedence value.

Consider the following when adding rules:

- Every ACL entry in an ACL is associated with a precedence value unique for every entry. You cannot enter two different entries in an ACL with the same precedence value. This value can be between 1 and 5000. An ACE in an ACL is associated with a unique precedence value. No two ACE's can have the same precedence value.
- Specifying a precedence value with each ACL entry is not mandatory. If you do not want to specify one, the system automatically generates a precedence value starting with 10. Subsequent entries are added with precedence values of 20, 30 and so on. 10 is the default offset between any two rules in an ACL. However, if the user specifies a precedence value with an entry, that value overrides the default value. The user can also add an entry in between two subsequent entries (for example, in between 10 and 20).
- If an entry with a max precedence value of 5000 exists, you cannot add a new entry with a higher precedence value. In such a case, the system displays an error stating "*Rule with max precedence value exists"*. Either delete the entry or add new entries with precedence values less than 5000. A user can add a maximum of 500 ACE's in an ACL.
- Rules within an ACL are displayed in an ascending order of precedence.

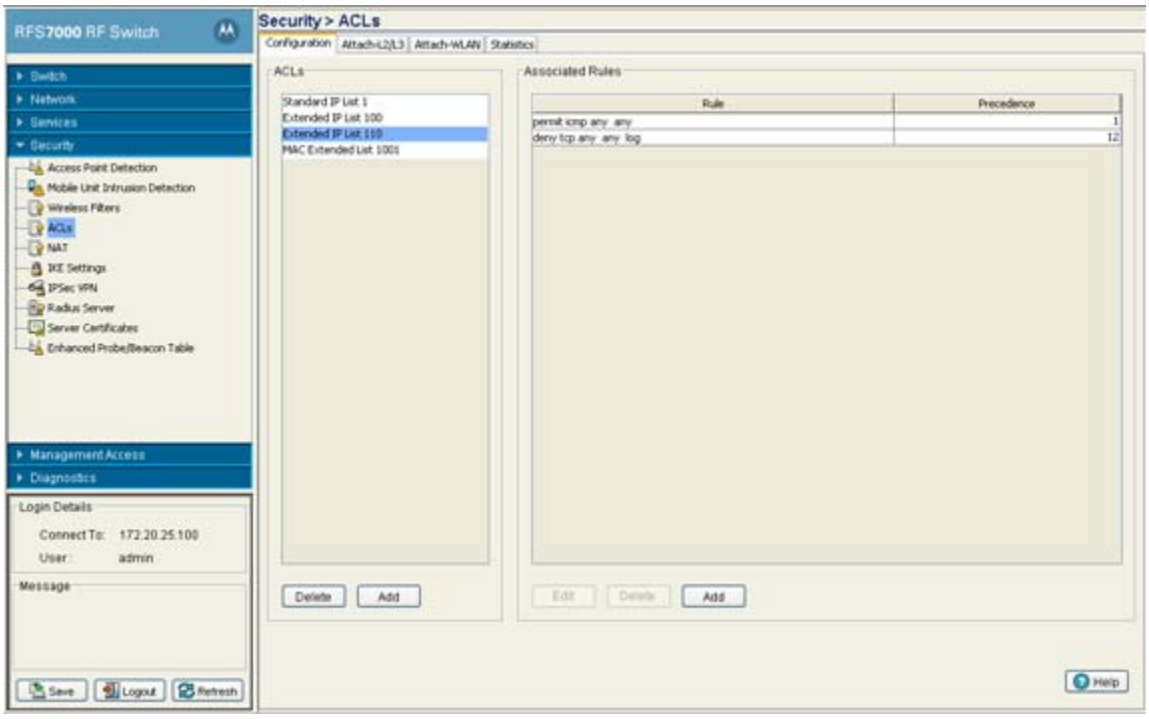
NOTE ACEs with lower precedence are always applied first to packets. Therefore, it is advised to add more specific entries in the ACL first then the general ones. While displaying the ACL, the entries are displayed in an ascending order of precedence.

6.5.2 Configuring an ACL

Configure an ACL to enforce privilege separation and determine appropriate switch access permissions for groups and users.

To configure an ACL:

1. Select **Security** > **ACLs** from the main tree menu.
2. Click the **Configuration** tab.
3. The Configuration tab consists of the following two fields:
   - *ACLs* - existing access lists
   - *Associated Rules* - allow/deny rules



The **ACLs** field displays the list of ACLs currently associated with the switch. An ACL contains an ordered list of ACEs. Each ACE specifies a permit or deny designation and a set of conditions the packet must satisfy to match the ACE. Because the switch stops testing conditions after the first match, the order of conditions in the list is critical.

4. If an existing ACL no longer satisfies switch access control requirements, select it from amongst the existing ACLs and click the **Delete** button.
5. Use the **Add** button (within the ACLs field) to add an additional ACL. For more information, see *Adding a New ACL on page 6-23*.
6. Refer to the **Associated Rules** field to assess the rules and precedence associated with each ACL. If necessary, rules and can be added or existing rules modified. For more information, see *Adding a New ACL Rule on page 6-24*.

6.5.2.1 Adding a New ACL

When a packet is received by the switch, the switch compares the packet against the ACL to verify the packet has the required permissions to be forwarded. Often, ACLs need to be added as client permission changes during switch operation.

To create a new ACL:

1. Select **Security** > **ACLs** from the main menu tree.
2. Click on the **Configuration** tab to view the list of ACLs currently associated with the switch.

3. Click on the **Add** button.

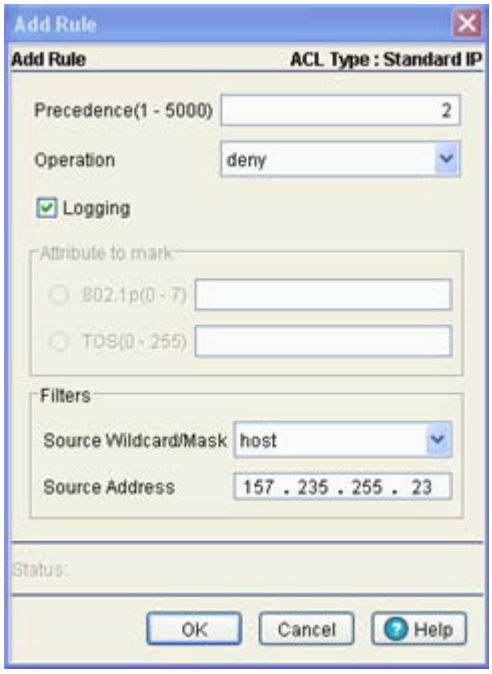
4. Select an **ACL Type** from the drop-down menu. The following options are available:
   - *Standard IP List* – Uses source IP addresses for matching operations
   - *Extended IP List* – Uses source and destination IP addresses and optional protocol type information for matching operations
   - *MAC Extended List* – Uses source and destination MAC addresses, VLAN ID and optional protocol type information.
5. Enter a numeric index name for the ACL in the **ACL ID** field.
6. Refer to the **Status** field for the current state of the requests made from applet. This field displays error messages if something goes wrong in the transaction between the applet and the switch.
7. Click **OK** to use the changes to the running configuration and close the dialog.
8. Click **Cancel** to close the dialog without committing updates to the running configuration.

6.5.2.2 Adding a New ACL Rule

To add a new rule:

1. Select **Security** > **ACLs** from the main menu tree.
2. Click the **Configuration** tab.

3. Click the **Add** button within the Associated Rules field.



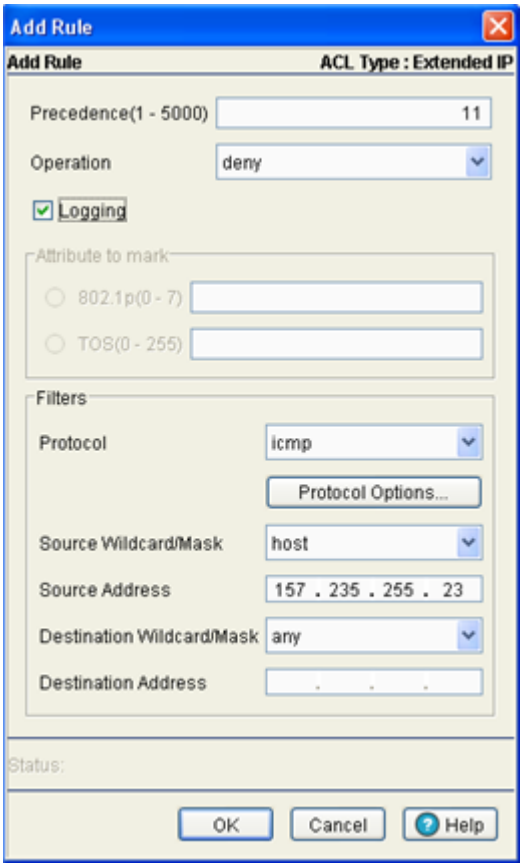
4. Use the **Precedence** field to enter a precedence (priority) value between 1 and 5000.

   The rules within an ACL will be applied to packets based on their precedence value. Rules with lower precedence are always applied first.

NOTE If adding an access control entry to an ACL using the switch SNMP interface, **Precedence** is a required parameter.

5. Use the **Operation** drop-down menu to define a permit, deny or mark designation for the ACL. If the action is to mark, the packet is tagged for priority.
6. Select the **Logging** checkbox to generate log messages when a packet has been forwarded, denied or marked based on the criteria specified in the access lists.
7. If **mark** is selected from within the **Operations** drop-down menu, the **Attribute to mark** field is enabled. Select the **802.1p (0 - 7)** or **TOS(0 - 255)** checkbox and define the attribute receiving priority with this ACL mark designation.
8. If the selected **Protocol** is **icmp**, click the **Protocol Options** button to configure the **ICMP Type** and **ICMP Code**.

NOTE If wanting to block ICMP requests from an MU to the switch, set the ICMP type to 8 and the code to 0.



9. If the selected **Protocol** is **tcp** or **udp**, click the **Protocol Options** button to configure the source and destination Port.
10. Use the **Source Address** field to enter the IP address from where the packets are sourced.
11. Refer to the **Status** field for the current state of the requests made from applet. This field displays error messages if something is wrong in the transaction between the applet and the switch.
12. Click **OK** to use the changes to the running configuration and close the dialog.
13. Click **Cancel** to close the dialog without committing updates to the running configuration.

6.5.2.3 Editing an Existing Rule

As network and access permission requirements change, existing ACL rules need to be modified to be relevant with new client access requests.

To modify an existing ACL rule:

1. Select **Security** > **ACLs** from the main menu tree.
2. Click on the **Configuration** tab.
3. Select an ACL from the ACLs field.

   The rules associated with the selected ACL display in the Associated Rules section.
4. Click the **Edit** button within the Associated Rules field.
5. Use the **Precedence** field to modify the precedence (priority) value between 1 and 5000.

The rules within an ACL are applied to packets based on their precedence value. Rules with lower precedence are always applied first.

NOTE If adding an access control entry to an ACL using the switch SNMP interface, **Precedence** is a required parameter.

6. Use the **Operation** drop-down menu (if necessary) to modify the permit, deny or mark designation for the ACL. If the action is to mark, the packet is tagged for priority.
7. Select the **Logging** checkbox to allow the log messages to be generated when a packet has been forwarded, denied or marked based on the criteria specified in the access lists.
8. If **mark** is selected from within the **Operations** drop-down menu, the **Attribute to mark** field becomes enabled. If necessary, select the **802.1p (0 - 7)** or **TOS(0 - 255)** checkbox and define the attribute receiving priority with this ACL mark designation.
9. From within the **Filters** field, modify (if necessary) the **Protocol** from the drop-down menu. The switch supports ACL rule filters for the following protocols: icmp, ip, tcp, udp.
10. If the selected **Protocol** is **icmp**, (if necessary) click the **Protocol Options** button to modify the **ICMP Type** and **ICMP Code**.

NOTE If wanting to block icmp requests from an MU to the switch, set the icmp type to 8 and the code to 0.

11. If the selected **Protocol** is **tcp** or **udp**, (if necessary) click the **Protocol Options** button to modify the source and destination **Port**.
12. From within the **Filters** field, modify (if necessary) the **Source Wildcard/Mask** from the drop-down menu.

    The source is the source address of the network or host in dotted decimal format. The Source-mask is the network mask.
13. Use the **Source Address** field to edit (if necessary) the IP address from where the packets are sourced.
14. Refer to the **Status** field for the current state of the requests made from applet. This field displays error messages if something goes wrong in the transaction between the applet and the switch.
15. Click **OK** to use the changes to the running configuration and close the dialog.
16. Click **Cancel** to close the dialog without committing updates to the running configuration.

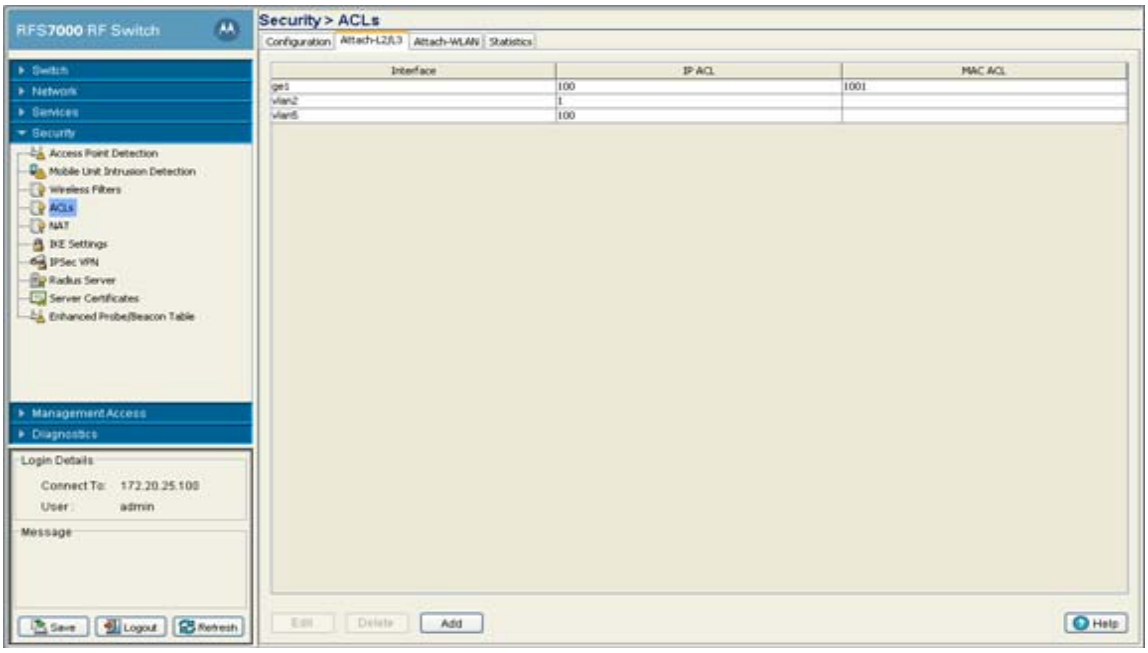
6.5.3 Attaching an ACL L2/L3 Configuration

Use the **Attach** tab to view and assign the ACL to a physical interface or VLAN on the switch.

To attach an interface:

1. Select **Security** > **ACLs** from the main menu tree.

2. Click the **Attach-L2/L3** tab.



3. Refer to the following information as displayed within the Attach - L2/L3 tab:

Interface	Displays the interface on which the ACL is applied. Available interfaces include ge1, ge2, ge3, ge4 and VLAN1.
IP ACL	Displays an IP ACL attached to the L2 or L3 interface in the inbound direction.
MAC ACL	Displays the MAC ACL attached to the L2 interface in the inbound direction.

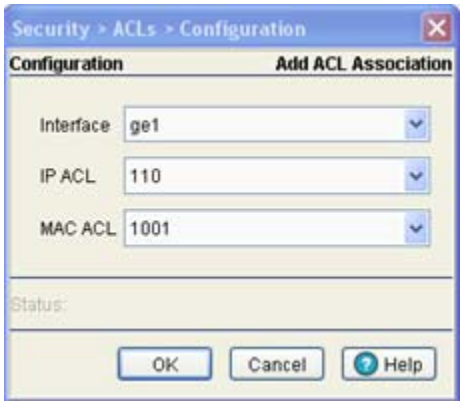
4. Select an interface and click on **Edit** to modify the ACL interface, IP ACL and MAC ACL values.
5. Select an interface and click the **Delete** button to delete the ACL from the list available (but not from the switch).
6. Click on **Add** button to add an physical or VLAN interface to the switch. For more information, see *Adding a New ACL L2/L3 Configuration on page 6-28*.

6.5.3.1 Adding a New ACL L2/L3 Configuration

After creating an ACL, it can be applied to one or more interfaces. ACLs are applied on layer 2 and layer 3 interfaces in the inbound direction only. To add an ACL interface to the switch:

1. Select **Security** > **ACLs** from the main menu tree.
2. Click on the **Attach-L2/L3** tab.

3. Click on the **Add** button.



4. Use the **Interface** drop-down menu to select the interface to configure on the switch. Available options include – ge1, ge2, ge3, ge4, and VLAN1. As additional VLANs are created, they also become available.
5. Use the **IP ACL** drop-down menu to select an IP ACL to attach to the L2 or L3 interface used in the inbound direction.
6. Use the **MAC ACL** drop-down menu to select a MAC ACL to attach to a L2 interface used in the inbound direction. A MAC ACL requires creation before it can be selected from this screen, if necessary return to *Configuring an ACL on page 6-22* and create a MAC ACL.
7. Refer to the **Status** field for the current state of the requests made from applet. This field displays error messages if something goes wrong in the transaction between the applet and the switch.
8. Click **OK** to use the changes to the running configuration and close the dialog.
9. Click **Cancel** to close the dialog without committing updates to the running configuration.

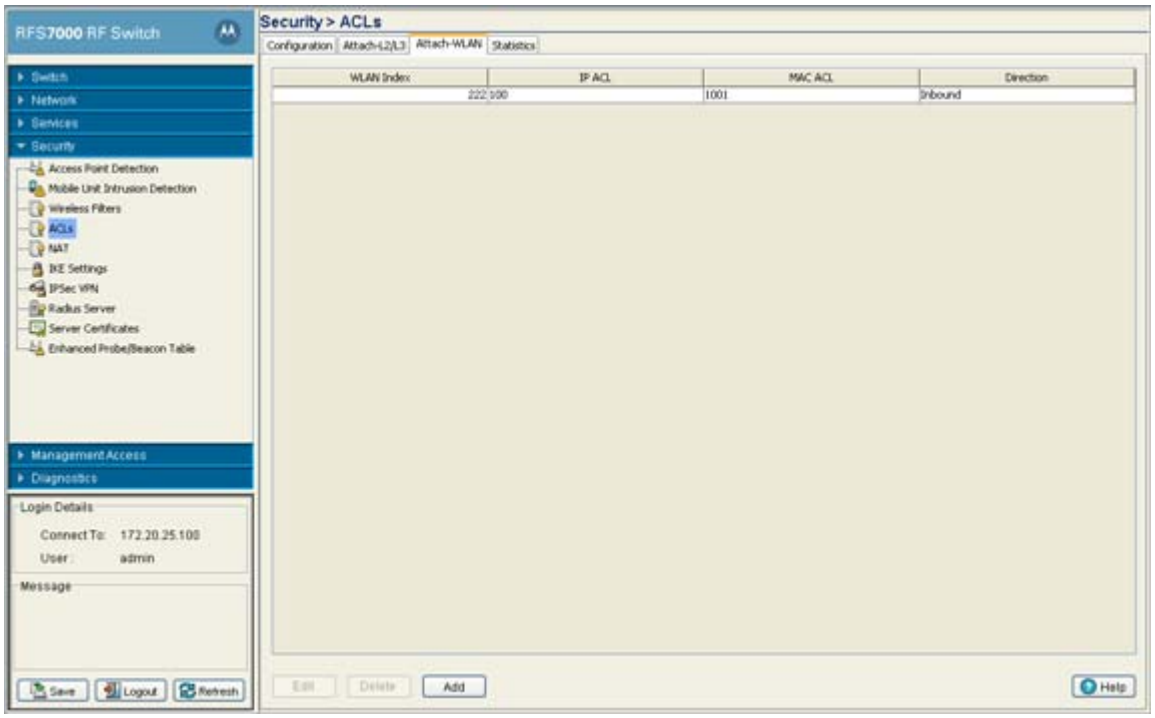
6.5.4 Attaching an ACL on a WLAN Interface/Port

Use the **Attach-WLAN** tab to view and assign an ACL to a WLAN on the switch. By default, arp is not supported. Create a MAC ACL to allow arp on the switch.

NOTE WLAN based ACLs allows users to enforce rules/ACLs on both the inbound and outbound direction, as opposed to L2 ACLs, which just support the inbound direction.

To attach an interface:

1. Select **Security** > **ACLs** from the main menu tree.
2. Click the **Attach-WLAN** tab.



3. Refer to the following information as displayed within the Attach - L2/L3 tab:

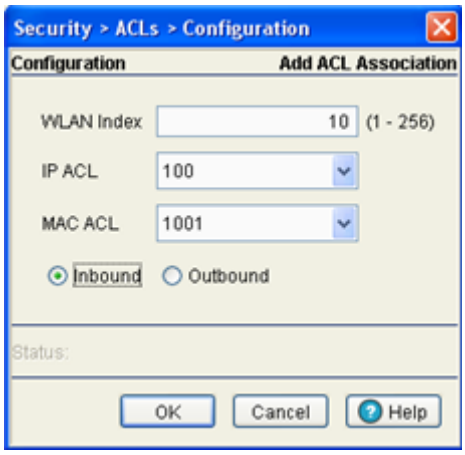
WLAN Index	The WLAN Index displays the list of WLANs attached with ACLs.
IP ACL	Displays the IP ACL configured.
MAC ACL	Displays the MAC ACL configured.
Direction	Displays whether the ACL is configured to work in the inbound or outbound direction.

4. Select a WLAN (by row) and click **Edit** to modify the WLAN Index, IP ACL and MAC ACL values. For more information, see *Adding or Editing a New ACL WLAN Configuration on page 6-31*.
5. Select a row and click the **Delete** button to delete the ACL from the list available (but not from the switch).
6. Click on **Add** button to add an ACL to a WLAN interface. For more information, see *Adding or Editing a New ACL WLAN Configuration on page 6-31*.

6.5.4.1 Adding or Editing a New ACL WLAN Configuration

After creating an ACL, it can be applied to one or more WLANs on the switch. To attach an ACL to a WLAN:

1. Select **Security** > **ACLs** from the main menu tree.
2. Click on the **Attach-WLAN** tab.
3. Click the **Add** button.



4. Define a **WLAN Index** between 1 and 256. If editing the ACL configuration, the index is read only and cannot be modified.
5. Use the **IP ACL** drop-down menu to select an IP ACL to configure for the WLAN interface.
6. Use the **MAC ACL** drop-down menu to select the MAC ACL to configure for the WLAN interface.
7. Select either the **Inbound** or **Outbound** radio button to define which direction the ACL applies.
8. Refer to the **Status** field for the current state of the requests made from applet. This field displays error messages if something goes wrong in the transaction between the applet and the switch.
9. Click **OK** to use the changes to the running configuration and close the dialog.
10. Click **Cancel** to close the dialog without committing updates to the running configuration.

6.5.5 Reviewing ACL Statistics

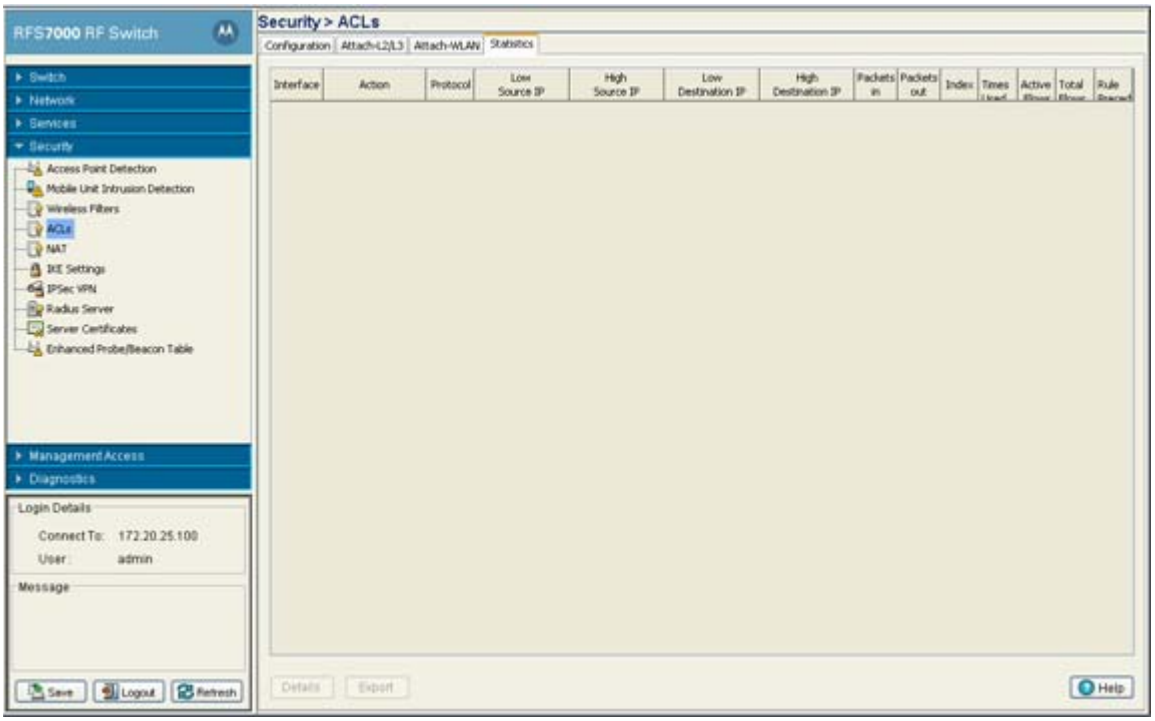
Use the **Statistics** tab to view set of statistics for those ACLs defined for use with the switch. The Statistics tab only displays data for router ACLs.

NOTE ACL statistics are only displayed for router ACLs.

To review ACL statistics:

1. Select **Security** > **ACLs** from the main menu tree.

2. Click the **Statistics** tab.



3. Refer to the following information as displayed within the **Statistics** tab:

Interface	Displays the ge1, ge2, ge3, ge 4 or VLAN 1 interface used to add the ACL association to the switch. As additional VLANs are added beyond the default VLAN1, they too become available.
Action	Displays the permit, deny or mark designation for the ACL. If the action is to mark, the packet is tagged for priority or "type of service."
Protocol	Displays the protocol used with the ACL. Available options include icmp, ip, tcp and udp.
Low Source IP	Displays the Low Source IP Address from where the packets are sourced.
High Source IP	Displays the High Source (highest address in available range) IP Address from where the packets are sourced.
Low Destination IP	Displays the Low Destination (lowest address in available range) IP Address.
High Destination IP	Displays the High Destination IP Address.
Packets In	Displays the number of packets (in bytes) transmitted over the ACL.
Packets Out	Displays the number of instances this ACL has been used. Periodically review to determine whether specific ACLs should be deleted or modified to make relevant.

4. Select an interface and click the **Delete** button to delete the ACL interface from the switch.
5. Click the **Export** to export the selected ACL attribute to a user specified location.

6.6 Configuring NAT Information

Network Address Translation (NAT) provides the translation of an *Internet Protocol* (IP) address within one network to a different, known IP address within another network. NAT involves re-writing the source and/or destination addresses of IP packets as they pass through a router or firewall. Most systems use NAT to enable multiple hosts on a private network to access the Internet using a single public IP address.

Using NAT, a user can mark one or more interfaces as inside or outside. When a user creates a NAT rule for inside or outside application, it is applied on all the interfaces marked as inside or outside respectively. NAT operates on the switch to connect two networks together. An inside network is assigned addresses requiring conversion into valid addresses before packets can be forwarded to an outside network. The translation process operates in parallel with packet routing.

NAT enables network administrators to move a Web or FTP Server to another host without having to troubleshoot broken links. Change the inbound mapping with the new inside local address to reflect the new host. Configure changes to your internal network seemlessly since the only external IP address either belongs to the switch or from a pool of global addresses.

The switch NAT configuration process is divided into the following configuration activities:

- *Defining Dynamic NAT Translations*
- *Defining Static NAT Translations*
- *Configuring NAT Interfaces*
- *Viewing NAT Status*

6.6.1 Defining Dynamic NAT Translations

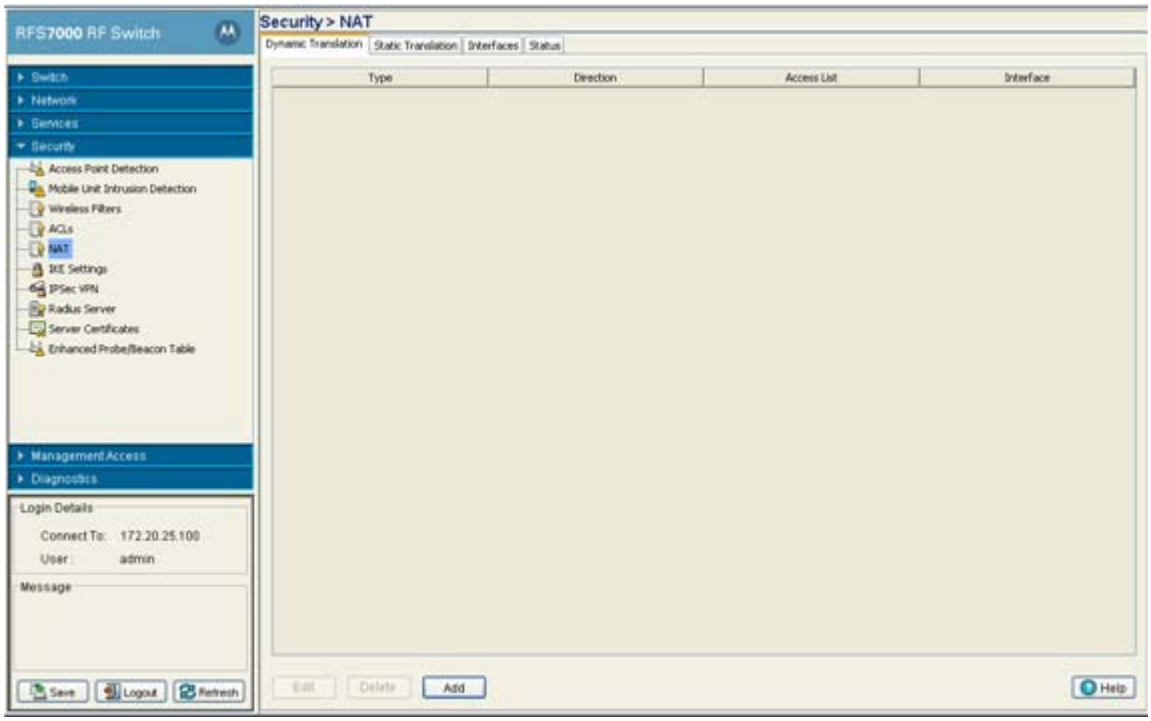
Dynamic NAT translates the IP address of packets going out from one interface to another interface based on the conditions configured in the list. Dynamic NAT requires packets to be switched through the NAT router to generate translations in the switch translation table.

Refer to the NAT screen's **Dynamic Translation** tab to view existing dynamic NAT configurations available to switch.

To view and add/edit a dynamic NAT configuration:

1. Select **Security** > **NAT** from the main menu tree.

2. Click on the **Dynamic Translation** tab.



3. Refer to the following information as displayed within the **Dynamic Translation** tab.

Type — Displays the NAT type as either:

- *Inside* - Applies NAT on packets arriving on interfaces marked as inside. These interfaces should be private networks not accessible from outside (public) networks.
- *Outside* - Applies NAT on packets coming in on interfaces marked as outside. These switch interfaces should be public or outside networks accessible from anywhere on the Internet.

Direction — Displays the direction as either:

- *Source* - The inside network is transmitting data over the network to its intended destination. On the way out, the source IP address is changed in the header and replaced by the (public) IP address.
- *Destination* - Packets passing through the NAT on the way back to the switch managed LAN are searched against the records kept by the NAT engine. The destination IP address is changed back to the specific internal private class IP address to reach the LAN over the switch managed network.

Access List — Defines the packet selection criteria for NAT. NAT is applied only on packets which match a rule defined in the access-list. Only the Standard IP and Extended IP Access List can be used.

Interface	Defines the interface through which packets are routed. The source IP address and source port number (only if IP protocol is TCP or UDP) of packets is changed to the interface IP address and a random port number.

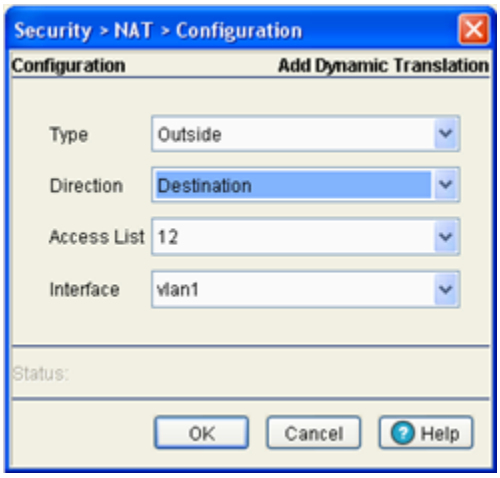
4. Select an existing NAT configuration and click the **Edit** button to modify the settings of this existing NAT configuration. The fields within the Edit screen are similar to those displayed when adding a new NAT configuration.
5. Select an existing NAT configuration and click the **Delete** button to remove it from the list of available configurations displayed.
6. Click the **Add** button to display a screen to create a new NAT configuration and add it to the list of available configurations. For more information, see *Adding a New Dynamic NAT Configuration on page 6-35*.

6.6.1.1 Adding a New Dynamic NAT Configuration

If the existing NAT configurations displayed with the Configuration prove unsuitable for translation, consider creating a new one.

To define a new NAT configuration:

1. Select **Security** > **NAT** from the main menu tree.
2. Click on the **Dynamic Translation** tab.
3. Click the **Add** button.



4. Define the NAT **Type** from the drop-down menu. Options include:
   - *Inside* - The set of networks subject to translation. These are the internal addresses you are trying to prevent from being exposed to the outside world.
   - *Outside* - All other addresses. Usually these are valid addresses located on the Internet. Outside addresses pose no risk if exposed over a publicly accessible network.
5. Define the NAT **Direction** from the drop-down menu. Options include:
   - *Source* - The inside network is transmitting data over the network its intended destination. On the way out, the source IP address is changed in the header and replaced by the (public) IP address.
   - *Destination* - Packets passing through the NAT on the way back to the switch managed LAN are searched against to the records kept by the NAT engine. There the destination IP address is changed

back to the specific internal private class IP address in order to reach the LAN over the switch managed network.

6. Use the **Access List** drop-down menu to select the list of addresses used during NAT translation. These addresses (once translated) will not be exposed to the outside world when the translation address is used to interact with the remote destination.
7. Use the **Interface** drop-down menu to select the VLAN used as the communication medium between the source and destination points within the NAT configuration. Ensure the VLAN selected represents the intended network traffic within the NAT supported configuration. VLAN1 is available by default.
8. Refer to the **Status** field for the current state of the requests made from applet. This field displays error messages if something goes wrong in the transaction between the applet and the switch.
9. Click **OK** to use the changes to the running configuration and close the dialog.
10. Click **Cancel** to close the dialog without committing updates to the running configuration.

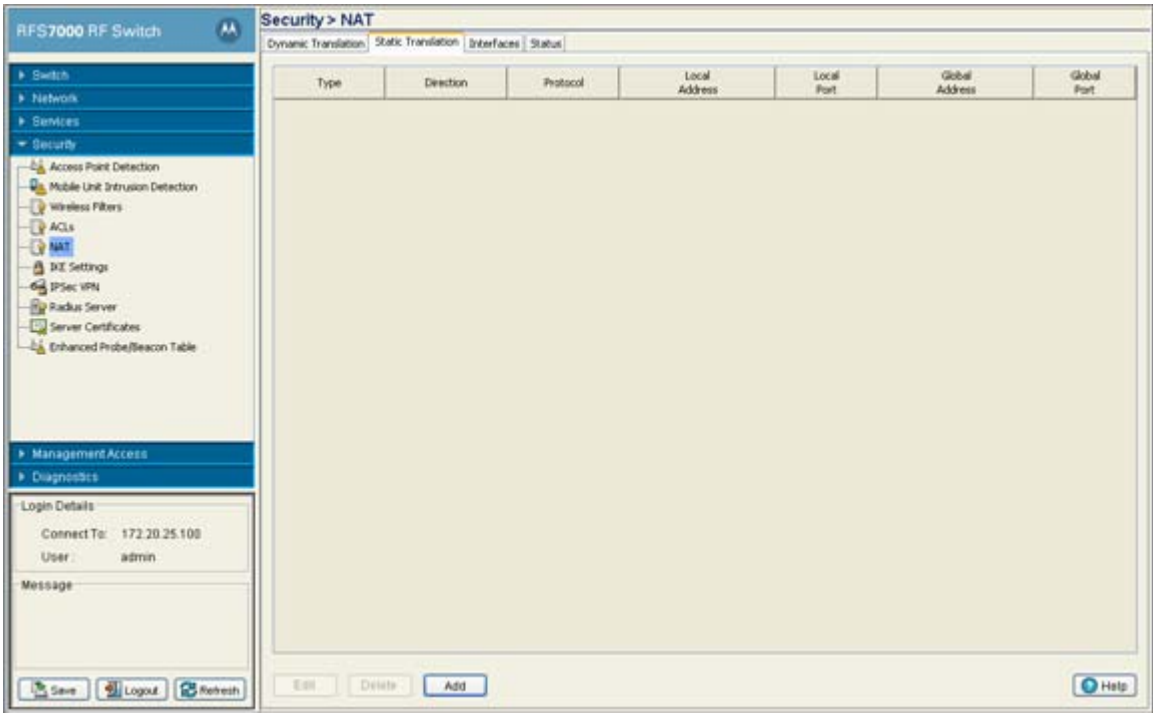
6.6.2 Defining Static NAT Translations

Static NAT creates a permanent, one-to-one mapping between an address on an internal network and a perimeter or external network. To share a Web server on a perimeter interface with the Internet, use static address translation to map the actual address to a registered IP address. Static address translation hides the actual address of the server from users on insecure interfaces. Casual access by unauthorized users becomes much more difficult. Static NAT requires a dedicated address on the outside network for each host.

Refer to the NAT screen's **Static Translation** tab to view existing static NAT configurations available to switch.

To view and add/edit a dynamic NAT configuration:

1. Select **Security** > **NAT** from the main menu tree.
2. Click on the **Static Translation** tab.



3. Refer to the following information as displayed within the **Static Translation** tab.

Type	Displays the NAT type as either: • *Inside* - The set of networks subject to translation. These are the internal addresses you are trying to prevent from being exposed to the outside world. • *Outside* - All other addresses. Usually valid addresses located on the Internet. Outside addresses pose no risk if exposed over a publicly accessible network.
Direction	Displays the Direction as either: • *Source* - The inside network is transmitting data over the network its intended destination. On the way out, the source IP address is changed in the header and replaced by the (public) IP address. • *Destination* - Packets passing through the NAT on the way back to the switch managed LAN are searched against to the records kept by the NAT engine. There the destination IP address is changed back to the specific internal private class IP address to reach the LAN over the switch managed network.
Protocol	Applies NAT on packets matching the specified IP protocol. Valid values can only be **tcp** or **udp**.
Local Address	Applies NAT on packets matching the specified IP address. The NAT engine matches the source IP or destination IP based on the direction specified. This option is valid only if the direction specified is **destination.**
Local Port	Applies NAT on packets matching the specified port number. The port number matched can be either source or destination based on the direction specified. This option is valid only if the direction specified is **destination.**
Global Address	Modifies the IP address of the matching packet to the specified value. The IP address modified can be either source or destination based on the direction specified.
Global Port	Modifies the port number of the matching packet to the specified value. This option is valid only if the direction specified is **destination.**

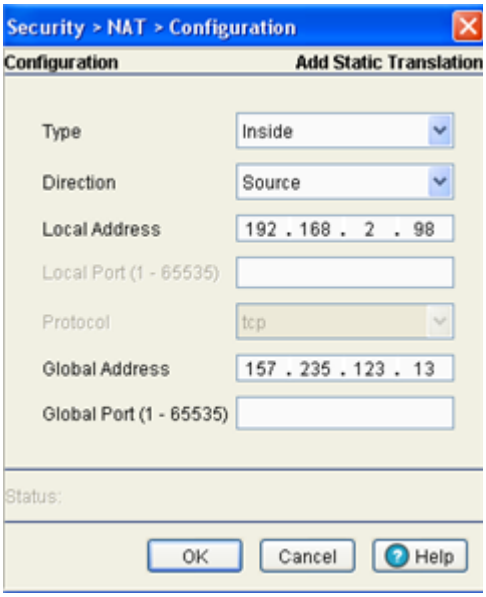
4. Select an existing NAT configuration and click the **Edit** button to display screen to modify the settings of this existing NAT configuration. The fields within the Edit screen are similar to those displayed when adding a new NAT configuration.
5. Select an existing NAT configuration and click the **Delete** button to remove it from the list of available configurations displayed.
6. Click the **Add** button to display screen to create a new NAT configuration and add it to the list of available configurations. For more information, see *Adding a New Dynamic NAT Configuration on page 6-35*.

6.6.2.1 Adding a New Static NAT Configuration

If the existing NAT configurations displayed with the Configuration prove unsuitable for translation, consider creating a new one.

To define a new NAT configuration:

1. Select **Security** > **NAT** from the main menu tree.
2. Click on the **Static Translation** tab.
3. Click the **Add** button.



4. Define the NAT **Type** from the drop-down menu. Options include:
   - *Inside* - The set of networks subject to translation. These are the internal addresses you are trying to prevent from being exposed to the outside world.
   - *Outside* - All other addresses (usually valid addresses located on the Internet). Outside addresses pose no risk if exposed over a publicly accessible network.
5. Define the NAT **Direction** from the drop-down menu. Options include:
   - *Source* - The inside network is transmitting data over the network its intended destination. On the way out, the source IP address is changed in the header and replaced by the (public) IP address.
   - *Destination* - Packets passing through the NAT on the way back to the switch managed LAN are searched against to the records kept by the NAT engine. There the destination IP address is changed back to the specific internal private class IP address to reach the LAN over the switch managed network.
6. Enter the **Local Address** used at the local (source) end of the NAT configuration. This address (once translated) will not be exposed to the outside world when the translation address is used to interact with the remote destination.
7. Enter the **Local Port (1 - 65535)** used to for the translation between the switch and its NAT destination.
8. Use the **Protocol** drop-down menu to select either **TCP** or **UDP** as the protocol.

NOTE After selecting (and saving) a protocol type of TCP or UDP (using the Web UI), the switch CLI will not display the selected protocol type or provide an option to configure it. Ensure both the protocol and port are defined using the Web UI.

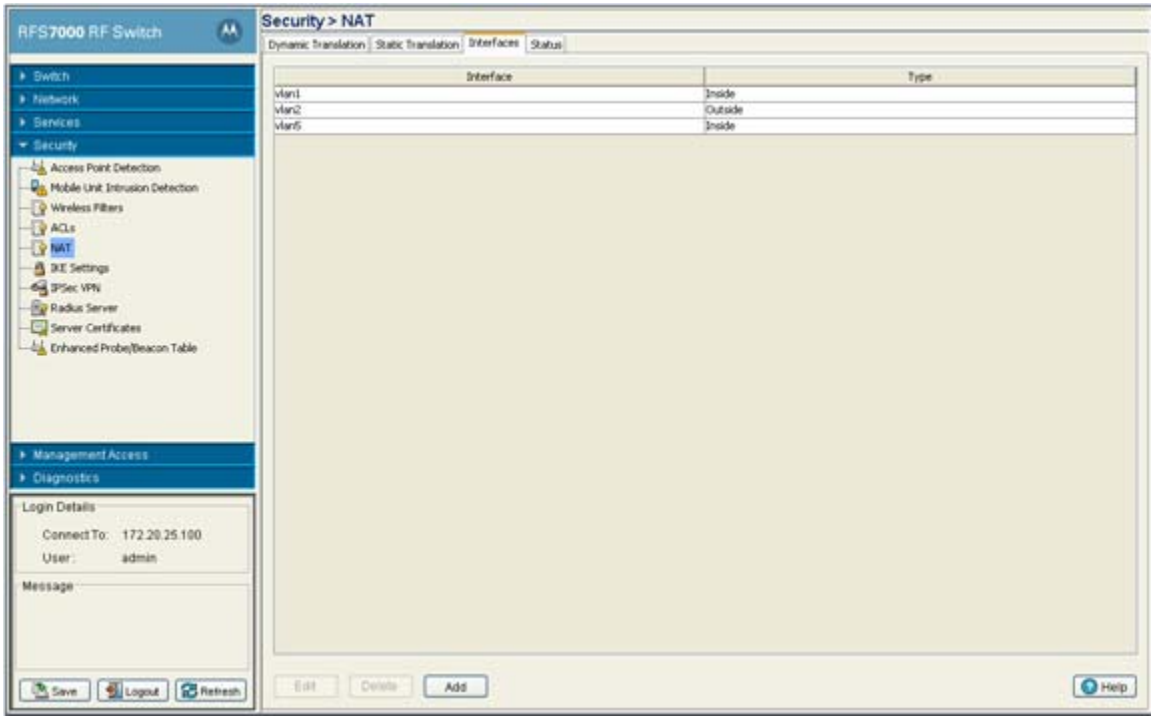
9. Enter the **Global Address** to assign to a host in the outside network. This should be interpreted as a secure address.
10. Displays the **Global Port** used to for the translation between the switch and its NAT destination.
11. Refer to the **Status** field for the current state of the requests made from applet. This field displays error messages if something is wrong in the transaction between the applet and the switch.
12. Click **OK** to use the changes to the running configuration and close the dialog.
13. Click **Cancel** to close the dialog without committing updates to the running configuration.

6.6.3 Configuring NAT Interfaces

The NAT Interface is the VLAN used to route switch data traffic between the source and destination address locations within the switch-managed network. Any of the default VLANs is available as the NAT interface, in addition to any other VLANs created. In addition to selecting the VLAN, specify the Inside or Outside NAT type.

To view and configure a NAT interface:

1. Select **Security** > **NAT** from the main menu tree.
2. Click on the **Interfaces** tab.



3. Refer to the following information as displayed within the **Interface** tab:

Interface	Displays the particular VLAN used as the inside or outside NAT type. All defined VLANs are available from the drop-down menu for use as the interface.
Type	Displays the NAT type as either: • *Inside* - The set of switch-managed networks subject to translation. These are the internal addresses you are trying to prevent from being exposed to the outside world. • *Outside* - All other addresses. Usually these are valid addresses located on the Internet. Outside addresses pose no risk if exposed over a publicly accessible network.

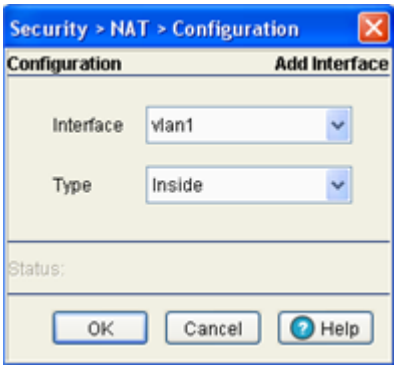
4. To Edit an existing interface, select it from the list of available interfaces and click the **Edit** button.

   An Edit Interface screen displays allowing the user to modify the VLAN and interface type (inside or outside).

5. If an interface is obsolete or of no use to the NAT translation process, select it and click the **Delete** button to remove it from the list of interfaces available

6. If modifying an existing interface is not a valid option, consider configuring a new interface. To define a new NAT interface:

   a. Click the **Add** button from within the Interfaces tab.



   b. Use the **Interface** drop-down menu to select the VLAN used as the communication medium between the switch managed network and its destination (within the insecure outside world).

   c. Use the **Type** drop-down menu to specific the Inside or Outside designation as follows:

      Inside - The set of switch-managed networks subject to translation. These are the internal addresses you are trying to prevent from being exposed to the outside world.

      Outside - All other addresses. Usually these are valid addresses located on the Internet. Outside addresses pose no risk if exposed over a publicly accessible network.

   d. Refer to the **Status** field for the current state of the requests made from applet. This field displays error messages if something goes wrong in the transaction between the applet and the switch.

   e. Click **OK** to use the changes to the running configuration and close the dialog.

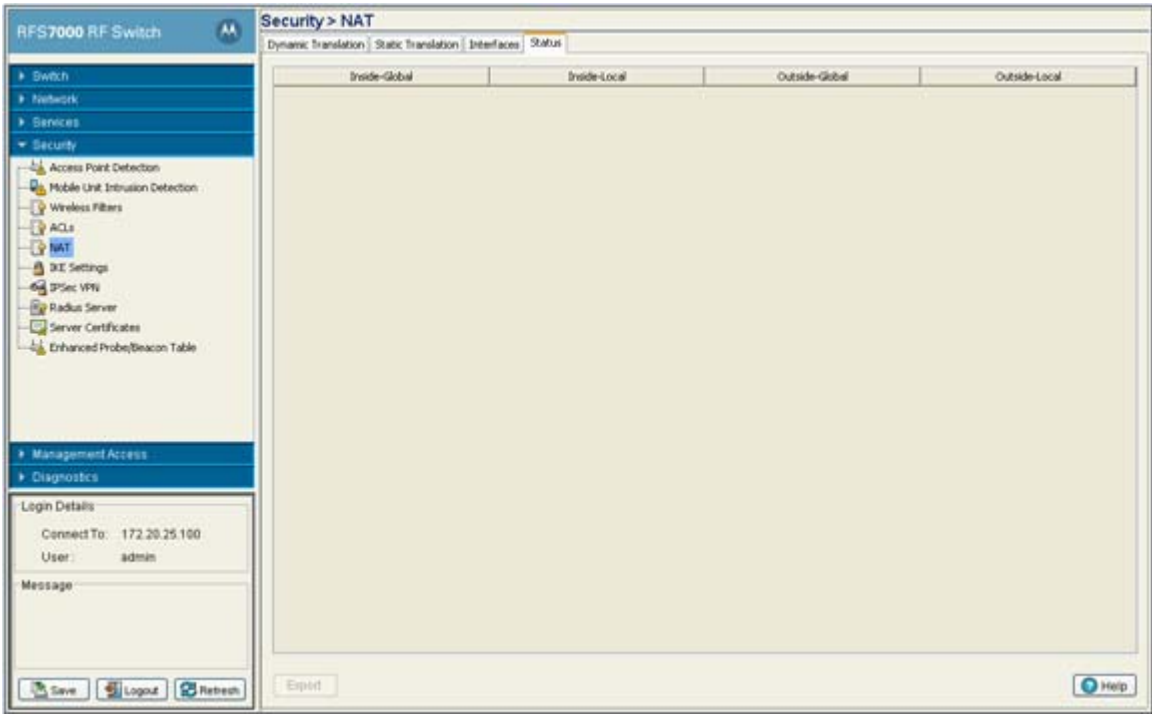
   f. Click **Cancel** to close the dialog without committing updates to the running configuration.

6.6.4 Viewing NAT Status

Use the **Status** tab to review the NAT translations configured thus far for the switch. The Status tab displays the inside and outside local and global IP addresses.

To view and configure a NAT interface:

1. Select **Security** > **NAT** from the main menu tree.
2. Click on the **Status** tab.



3. Refer to the following to assess the validity and total NAT translation configurations available to the switch.

Inside-Global	NATed source IP address of the packet for source NAT translation. This address will be same as the inside local address for destination NAT translation.
Inside Local	Actual source IP address of the packet.
Outside-Global	NATed destination IP address of the packet for the destination NAT translation. This address will be same as the outside local address for source NAT translation.
Outside-Local	Actual destination IP address of the packet.

4. Click on the **Export** button to export the contents of the table to a *Comma Separated Values* file (CSV).

6.7 Configuring IKE Settings

IKE (also known as ISAKMP) is the negotiation protocol enabling two hosts to agree on how to build an IPSec security association. To configure the security appliance for virtual private networks, set global IKE parameters that apply system wide and define IKE policies peers negotiate to establish a VPN tunnel.

IKE protocol is an IPSec standard protocol used to ensure security for VPN negotiation, and remote host or network access. IKE provides an automatic means of negotiation and authentication for communication between two or more parties. IKE manages IPSec keys automatically.

The IKE configuration is defined by the following:

- *Defining the IKE Configuration*
- *Setting IKE Policies*
- *Viewing SA Statistics*

NOTE By default, IKE feature is enabled on the switch. Motorola does not support disabling the IKE service.

NOTE The default isakmp policy will not be picked up for IKE negotiation if another crypto isakmp policy is created. For the default isakmp policy to be picked up for AAP adoption you must first create the default isakmp policy as a new policy with default parameters. This needs to be done if multiple crypto isakmp policies are needed in the switch configuration.

6.7.1 Defining the IKE Configuration

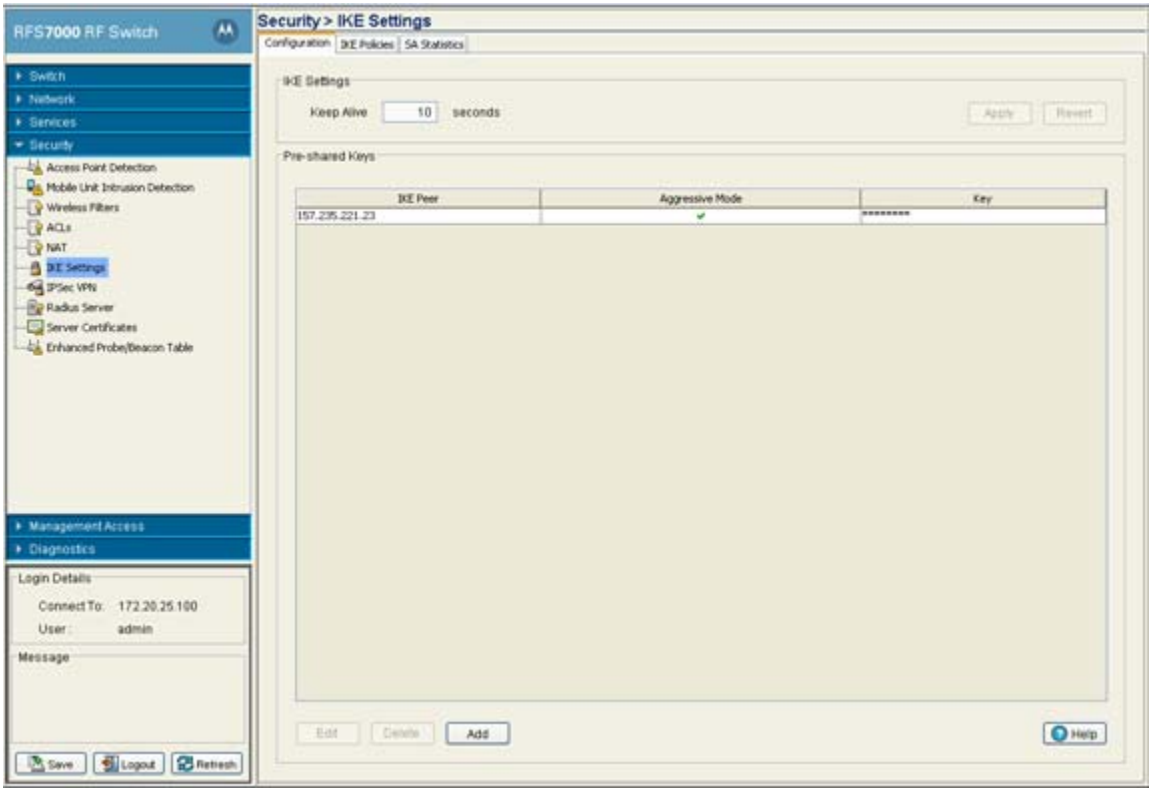
Refer to the **Configuration** tab to enable (or disable) IKE and define the IKE identity (for exchanging identities) and aggressive mode. Aggressive mode reduces messages exchanged when establishing IKE SAs (used in phase 2).

Use IKE to specify IPSec tunnel attributes for an IPSec peer and initiate an IKE aggressive mode negotiation with the tunnel attributes. This feature is best implemented in a crypto hub scenario. Users initiate IKE aggressive mode negotiation with the switch using pre-shared keys specified as tunnel attributes. This scenario is scalable since the keys are kept at a central repository (the Radius server) and more than one switch and application can use the information.

To view the current set of IKE configurations:

1. Select **Security** > **IKE Settings** from the main menu tree.

2. Click the **Configurations** tab.



During IKE negotiations, peers must identify themselves to one another. Thus, the configuration you define is the identification medium for device recognition.

3. Set a **Keep Alive** interval (in seconds) the switch uses for monitoring the continued presence of a peer and report of the client's continued presence. The client notifies you when the peer is no longer present. The default interval is 10 seconds.
4. Click the **Apply** button (within the IKE Settings field) to save the configuration.
5. Click the **Revert** (within the IKE Settings field) to rollback to the previous configuration.
6. Refer to the **Pre-shared Keys** field to review the following information:

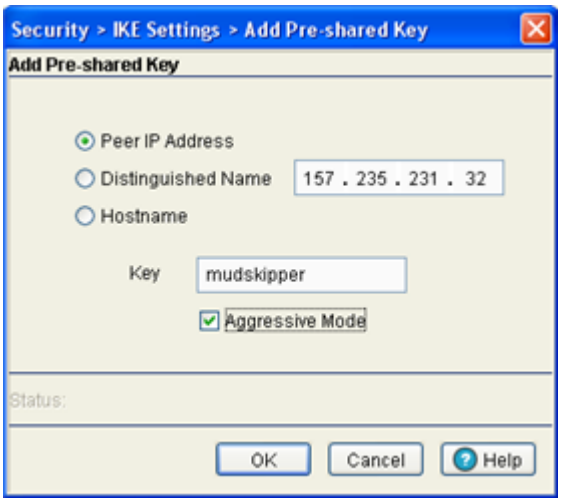
Peer IP Address	Use the Peer IP Address to associate an IP address with the specific tunnel used by a group of peers.
Aggressive Mode	Displays whether aggressive mode is enabled for this IP address and key string. A green check mark defines aggressive mode as enabled. A red "X" denotes the mode as disabled.
Key	Displays the string ID a remote peer uses to look up pre-shared keys.

NOTE Please note that RSA keys are not supported for IKE negotiation on this switch.

.

7. Highlight an existing set of pre-shared Keys and click the **Edit** button to revise the existing peer IP address, key and aggressive mode designation.

8. Select an existing entry and click the **Delete** button to remove it.
9. If the properties of an existing peer IP address, key and aggressive mode designation are no longer relevant and cannot be edited, click the **Add** button to create a new pre-shared key.



   a. Select the **Peer IP Address** checkbox to associate an IP address with the specific tunnel used by a group of peers or, select the **Distinguished Name** checkbox to configure the switch to restrict access to those peers with the same distinguished name, or select the **Hostname** checkbox to allow shared-key messages between corresponding hostnames.
   b. Define the **Key** (string ID) a remote peer uses to look up the pre-shared to interact securely with peers within the tunnel.
   c. Select the **Aggressive Mode** checkbox (if required). Aggressive mode enables you to configure IKE pre-shared keys as Radius tunnel attributes for IP Security (IPSec) peers.
   d. Refer to the **Status** field for the current state of requests made from applet. This field displays error messages if something is wrong in the transaction between the applet and the switch.
   e. Click **OK** to use the changes to the running configuration and close the dialog.
   f. Click **Cancel** to close the dialog without committing updates to the running configuration.

6.7.2 Setting IKE Policies

Each IKE negotiation is divided into two phases. Phase 1 creates the first tunnel (protecting later IKE negotiation messages) and phase 2 creates the tunnel protecting the data. To define the terms of the IKE negotiation, create one or more IKE policies. Include the following:

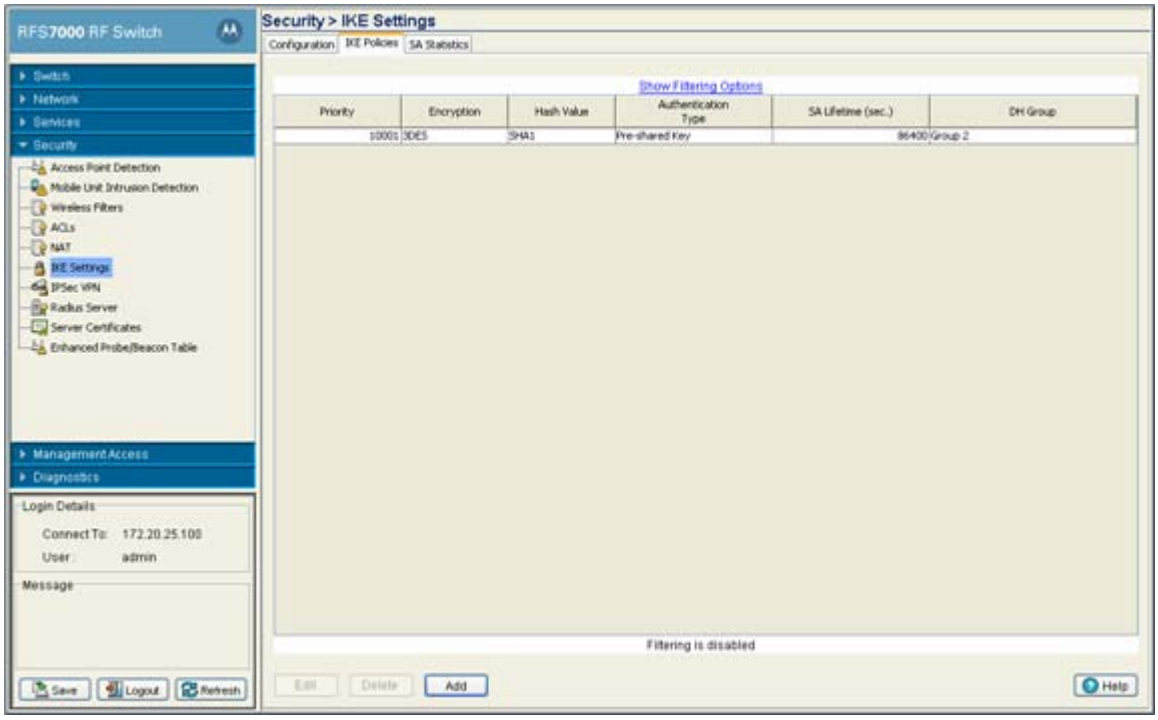
- An authentication scheme to ensure the credentials of the peers
- An encryption scheme to protect the data
- A HMAC method to ensure the identity of the sender, and validate a message has not been altered
- A Diffie-Hellman group establishing the strength of the of the encryption-key algorithm.
- A time limit for how long the encryption key is used before it is replaced.

If IKE policies are not defined, the switch uses the default policy (with a default priority of 10001) and contains the default values. When IKE negotiations begin, the peer initiating the negotiation sends its policies to the remote peer. The remote peer searches for a match with its own policies using the defined priority scheme.

A IKE policy matches when they have the same encryption, hash, authentication and Diffie-Hellman settings. The SA lifetime must also be less than or equal to the lifetime in the policy sent. If the lifetimes do not match, the shorter lifetime applies. If no match exists, IKE refuses negotiation.

To view the current set of IKE policies:

1. Select **Security** > **IKE Settings** from the main menu tree.
2. Click the **IKE Policies** tab.



3. Refer to the values displayed within the IKE Policies tab to determine if an existing policy requires revision, removal or a new policy requires creation.

Priority — Displays the priority for the IKE policy. The available range is from 1 to 10,000, with 1 being the highest priority value.

Encryption — Displays the encryption method protecting data transmitted between peers. Options include:

- *DES 56-bit DES-CBC*. The default value.
- *3DES - 168-bit Triple DES*.
- *AES - 128-bit AES*.
- *AES 192 - 192-bit AES*.
- *AES 256 - 256-bit AES*.

Hash Value — Displays the hash algorithm used to ensure data integrity. The hash value validates a packet comes from its intended destination, and has not been modified in transit. Options include:

- *SHA* - The default value.
- *MD5* - MD5 has a smaller digest and is somewhat faster than SHA-1.

Authentication Type	Displays the authentication scheme used to validate the identity of each peer. Pre-shared keys do not scale accurately with a growing network but are easier to maintain in a small network. Options include: • *Pre-shared Key* - Uses pre-shared keys. • *RSA Signature*- Uses a digital certificate with keys generated by the RSA signatures algorithm.
SA Lifetime	Displays an integer for the SA lifetime. The default is 60 seconds. With longer lifetimes, security defines future IPSec security associations quickly. Encryption strength is great enough to ensure security without using fast rekey times. Motorola recommends using the default value.
DH Group	Displays the *Diffie-Hellman* (DH) group identifier. IPSec peers use the defined value to derive a shared secret without transmitting it to one another.

NOTE: 192-bit AES and 256-bit AES are not supported for manual IPSec sa configurations.

4. Highlight an existing policy and click the **Edit** button to revise the policy's existing priority, encryption scheme, hash value, authentication scheme, SA lifetime and DH group.
5. Select an existing policy and click the **Delete** button to remove it from the table.
6. If the properties of an existing policy are no longer relevant and cannot be edited to be useful, click the **Add** button to define a new policy.

a. Configure a set of attributes for the new IKE policy:

Priority	Define the priority for the IKE policy. The available range is from 1 to 65,543, with 1 being the highest priority value.
Encryption	Set the encryption method used to protect the data transmitted between peers. Options include: • *DES 56-bit DES-CBC*. The default value. • *3DES - 168-bit Triple DES*. • *AES - 128-bit AES*. • *AES 192 - 192-bit AES*. • *AES 256 - 256-bit AES*.
Hash Value	Define the hash algorithm used to ensure data integrity. The hash value validates a packet comes from its intended source and has not been modified in transit. Options include: • *SHA* - The default value. • *MD5* - MD5 has a smaller digest and is somewhat faster than SHA-1.
Authentication Type	Set the authentication scheme used to validate the identity of each peer. Pre-shared keys do not scale accurately with a growing network but are easier to maintain in a small network. Options include: • *Pre-shared Key* - Uses pre-shared keys. • *RSA Signature*- Uses a digital certificate with keys generated by the RSA signatures algorithm.
SA Lifetime	Define an integer for the SA lifetime. The default is 60 seconds. With longer lifetimes, security defines future IPSec security associations quickly. Encryption strength is great enough to ensure security without using fast rekey times. Motorola recommends using the default value.
DH Group	Set the Diffie-Hellman group identifier. IPSec peers use the defined value to derive a shared secret without transmitting it to one another.

b. Refer to the **Status** field for the current state of the requests made from applet. This field displays error messages if something goes wrong in the transaction between the applet and the switch.

c. Click **OK** to use the changes to the running configuration and close the dialog.

d. Click **Cancel** to close the dialog without committing updates to the running configuration.

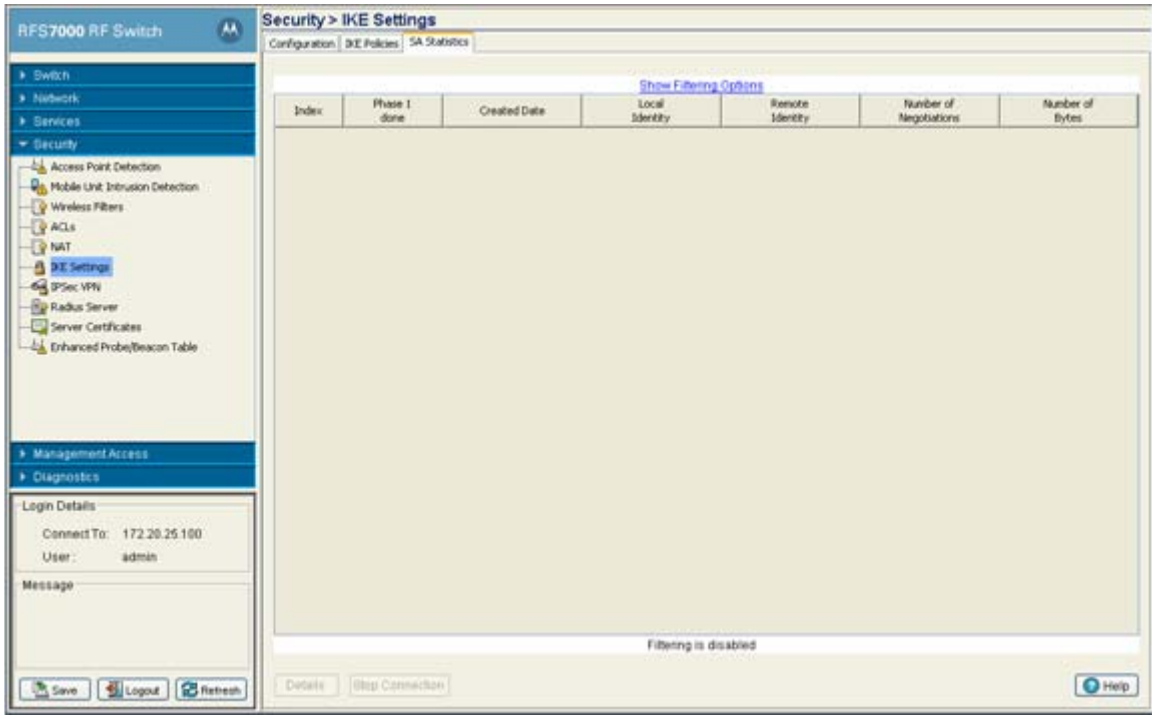
6.7.3 Viewing SA Statistics

A *security association* (SA) is a description of how two peers employ a security technique to interoperate securely. IKE requires SAs to identify connection attributes. IKE can negotiate and establish its own SA. An IKE SA is used by IKE only, and is bi-directional.

To view SA statistics:

1. Select **Security** > **IKE Settings** from the main menu tree.

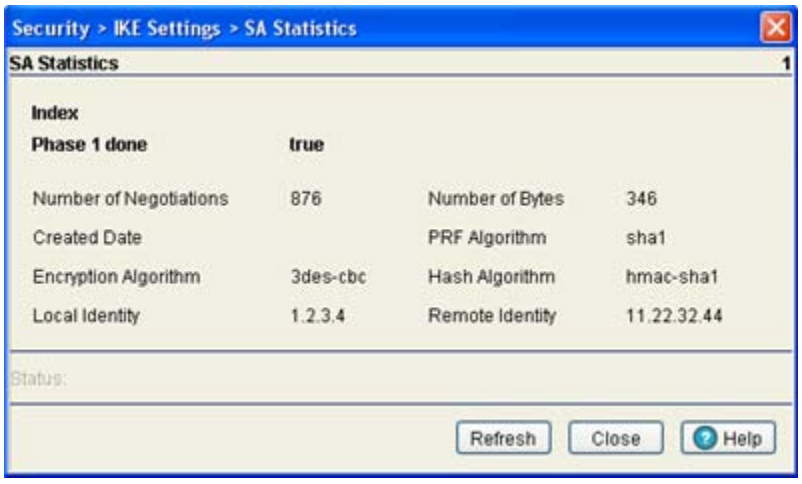
2. Click the **SA Statistics** tab.



3. Refer to the information displayed within SA Statistics tab to discern the following:

Index	Displays the alpha-numeric name (index) used to identify individual SAs.
Phase 1 done	Displays whether this index is completed with the phase 1 (authentication) credential exchanged between peers.
Created Date	Displays the exact date the SA was configured for each index displayed.
Local Identity	Specifies the address the local IKE peer uses to identify itself to the remote peer.
Remote Identity	Specifies the address the remote IKE peer uses to identify itself to a local peer.
Number of Negotiations	During IKE negotiations the peers must identify themselves to each other. This value is helpful in determining the network address information used to validate peers.
Number of Bytes	Displays the number of bytes passed between the peers for the specified index.

4. Select an index and click the **Details** button to display a more robust set of statistics for the selected index.



   Use this information to discern whether changes to an existing IKE configuration is warranted or if a new configuration is required.

5. Click the **Stop Connection** button to terminate the statistic collection of the selected IKE peer.

6.8 Configuring IPSec VPN

Use IPSec *Virtual Private Network* (VPN) to define secure tunnels between two peers. Configure which packets are sensitive and should be sent through secure tunnels, and what should be used to protect these sensitive packets. Once configured, an IPsec peer creates a secure tunnel and sends the packet through the tunnel to the remote peer.

IPSec tunnels are sets of *security associations* (SA) established between two peers. The security associations define which protocols and algorithms are applied to sensitive packets, and what keying material is used by the two peers. Security associations are unidirectional and established per security protocol.

To configure IPSec security associations, Motorola uses the Crypto Map entries. Crypto Map entries created for IPSec pull together the various parts used to set up IPSec security associations. Crypto Map entries include transform sets. A transform set is an acceptable combination of security protocols, algorithms and other settings to apply to IPSec protected traffic.

The *Internet Key Exchange* (IKE) protocol is a key management protocol standard used in conjunction with the IPSec standard. IKE automatically negotiates IPSec security associations and enables IPSec secure communications without costly manual configuration. To support IPSec VPN functionality, the following configuration activities are required:

- *Configuring a DHCP Sever to assign public IP address*

  An IPSec client needs an IP address before it can connect to the VPN Server and create an IPSec tunnel. A DHCP Server needs to be configured on the interface to distribute public IP addresses to the IPSec clients.

- *Configuring a Crypto policy (IKE)*

  IKE automatically negotiates IPSec security associations and enables IPSec secure communications without costly manual pre-configuration. IKE eliminates the need to manually specify all the IPSec security parameters in the Crypto Maps at both peers, allows you to specify a lifetime for the IPSec

security association, allows encryption keys to change during IPSec sessions and permits *Certification Authority* (CA) support for a manageable, scalable IPSec implementation. If you do not want IKE with your IPSec implementation, disable it for IPSec peers. You cannot have a mix of IKE-enabled and IKE-disabled peers within your IPSec network.

- *Configuring security associations parameters*

  The use of manual security associations is a result of a prior arrangement between switch users and the IPSec peer. If IKE is not used for establishing security associations, there is no negotiation of security associations, so the configuration information in both systems must be the same for traffic to be processed successfully by IPSec.

- *Defining transform sets*

  A transform set represents a combination of security protocols and algorithms. During the IPSec security association negotiation, peers agree to use a particular transform set for protecting data.

  With manually established security associations, there is no negotiation with the peer, so both sides must specify the same transform set. If you change a transform set definition, the change is only applied to Crypto Map entries that reference the transform set. The change is not applied to existing security associations, but is used in subsequent negotiations to establish new security associations.

- *Creating Crypto Map entries*

  When IKE is used to establish security associations, the IPSec peers can negotiate the settings they use for the new security associations. Therefore, specify lists (such as lists of acceptable transforms) within the Crypto Map entry.

- *Applying Crypto Map sets to Interfaces*

  Assign a Crypto Map set to each interface through which IPSec traffic flows. The security appliance supports IPSec on all interfaces. Assigning the Crypto Map set to an interface instructs the security appliance to evaluate all the traffic against the Crypto Map set and use the specified policy during connection or SA negotiation. Assigning a Crypto Map to an interface also initializes run-time data structures (such as the SA database and the security policy database). Reassigning a modified Crypto Map to the interface resynchronizes the run-time data structures with the Crypto Map configuration. With the switch, a Crypto Map cannot get applied to more than one interface at a time.

- *Monitoring and maintaining IPSec tunnels*

  New configuration changes only take effect when negotiating subsequent security associations. If you want the new settings to take immediate effect, clear the existing security associations so they will be re-established with the changed configuration.

  For manually established security associations, clear and reinitialize the security associations or the changes will not take effect.

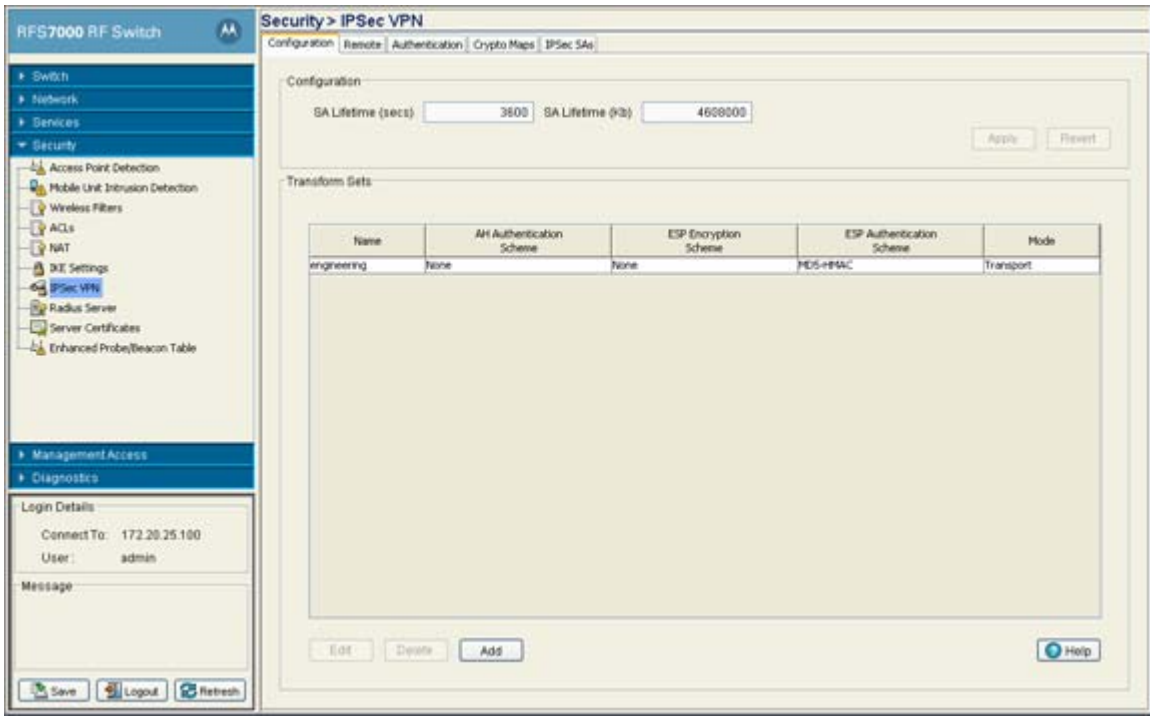
  For more information on configuring IPSec VPN, refer to the following:

  - *Defining the IPSec Configuration*
  - *Defining the IPSec VPN Remote Configuration*
  - *Configuring IPSEC VPN Authentication*
  - *Configuring Crypto Maps*
  - *Viewing IPSec Security Associations*

6.8.1 Defining the IPSec Configuration

Use the IPSec VPN **Configuration** tab to view the attributes of existing VPN tunnels and modify the security association lifetime and keep alive intervals used to maintain the sessions between VPN peers. From the Configuration tab, transform sets can be created as existing sets, modified or deleted.

1. Select **Security** > **IPSec VPN** from the main menu tree.
2. Click the **Configuration** tab.



3. Refer to the **Configuration** field to define the following:

SA Lifetime (secs)	For IKE based security associations, define a SA Lifetime (in seconds) forcing the periodically expiration and re-negotiation of peer credentials. Thus, continually validating the peer relationship. The default value is 3600 seconds.
SA Lifetime (Kb)	Causes the security association to time out after the specified amount of traffic (in kilobytes) have passed through the IPSec tunnel using the security association. The default value is 4608000 Kb.
Apply	Click **Apply** to save any updates you may have made to the screen.
Revert	Click the **Revert** button to disregard any changes you have made and revert back to the last saved configuration.

4. Refer to the **Transform Sets** field to view the following data:

Name	Displays a transform set identifier used to differentiate transform sets. The index is helpful when transform sets with similar attributes need to be revised or discarded.
AH Authentication Scheme	Displays the AH Transform Authentication scheme used with the index. Options include: • *None* - No AH authentication is used. • *AH-MD5-HMAC* - AH with the MD5 (HMAC variant) authentication algorithm. • *AH-SHA-HMAC* - AH with the SHA (HMAC variant) authentication algorithm.
ESP Encryption Scheme	Displays the ESP Encryption Transform used with the index. Options include: • *None* - No ESP encryption is used with the transform set. • *ESP-DES* - ESP with the 56-bit DES encryption algorithm. • *ESP-3DES* - ESP with 3DES, ESP with AES. • *ESP-AES* - ESP with 3DES, ESP with AES (128 bit key). • *ESP-AES 192* - ESP with 3DES, ESP with AES (192 bit key). • *ESP-AES 256*- ESP with 3DES, ESP with AES (256 bit key)
ESP Authentication Scheme	Displays the ESP Authentication Transform used with the index. Options include: • *None* - No ESP authentication is used with the transform set. • *MD5-HMAC* - AH with the MD5 (HMAC variant) authentication algorithm. • *SHA-HMAC* - AH with the SHA (HMAC variant) authentication algorithm.
Mode	Displays the current mode used with the transform set. The mode is either tunnel or transport.

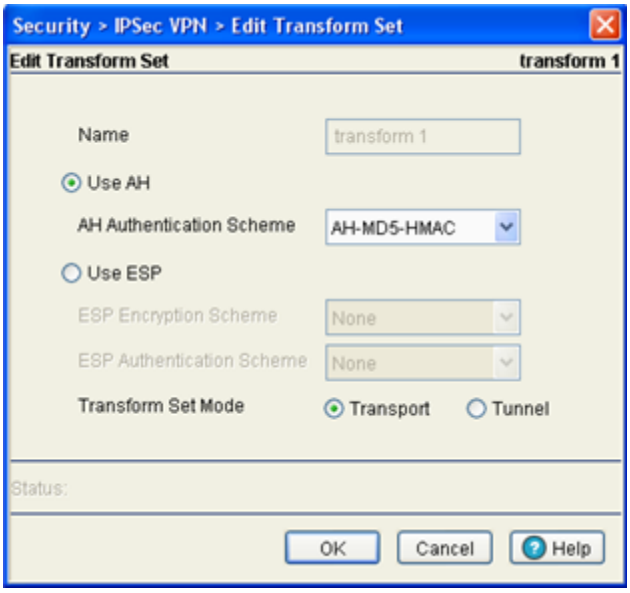
5. Select an IPSec VPN transform set (by its index) and click the **Edit** button to modify its properties. For more information, see *Editing an Existing Transform Set on page 6-52*.
6. Select an index and click the **Delete** button to remove it from the table.
7. If none of the transform sets displayed appear useful, click the **Add** button to create a new one. For more information, see *Adding a New Transform Set on page 6-54*.

6.8.1.1 Editing an Existing Transform Set

If the attributes of an existing transform set no longer lend themselves as useful, consider editing the transform set to be relevant with the needs of existing VPN peers.

To edit the attributes of an existing transform set:

1. Select **Security** > **IPSec VPN** from the main menu tree.
2. Click the **Configuration** tab.
3. Select an existing transform set and click the **Edit** button.



4. Revise the following information as required to render the existing transform set useful.

Name	The name is read-only and cannot be modified unless a new transform set is created.
AH Authentication Scheme	Select the **Use AH** checkbox (if necessary) to modify the AH Transform Authentication scheme. Options include: • *None* - No AH authentication is used. • *AH-MD5-HMAC* - AH with the MD5 (HMAC variant) authentication algorithm. • *AH-SHA-HMAC* - AH with the SHA (HMAC variant) authentication algorithm.
ESP Encryption Scheme	Select the **Use ESP** checkbox (if necessary) to modify the ESP Encryption Scheme. Options include: • *None* - No ESP encryption is used with the transform set. • *ESP-DES* - ESP with the 56-bit DES encryption algorithm. • *ESP-3DES* - ESP with 3DES, ESP with AES. • *ESP-AES* - ESP with 3DES, ESP with AES (128 bit key). • *ESP-AES 192* - ESP with 3DES, ESP with AES (192 bit key). • *ESP-AES 256*- ESP with 3DES, ESP with AES (256 bit key).
ESP Authentication Scheme	Select the **Use ESP** checkbox (if necessary) to modify the ESP Authentication Scheme. Options include: • *None* - No ESP authentication is used with the transform set. • *MD5-HMAC* - AH with the MD5 (HMAC variant) authentication algorithm. • *SHA-HMAC* - AH with the SHA (HMAC variant) authentication algorithm.
Mode	Modify (if necessary) the current mode used with the transform set. The mode is either Tunnel or Transport.

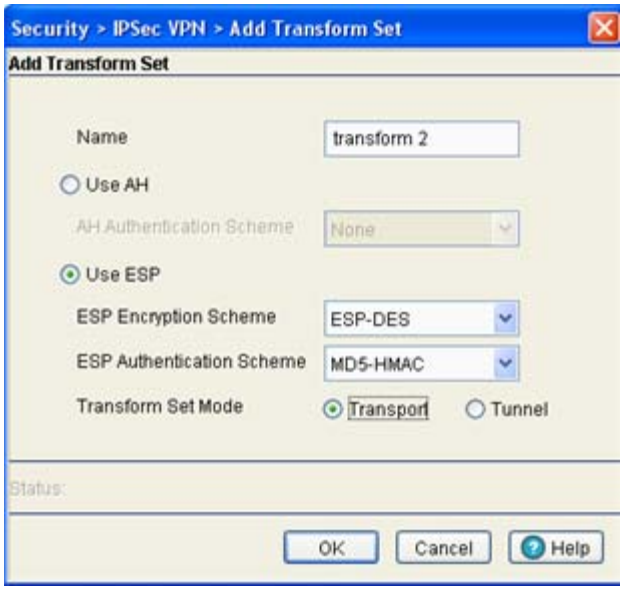
5. Refer to the **Status** field for the current state of the requests made from applet. This field displays error messages if something goes wrong in the transaction between the applet and the switch.
6. Click **OK** to use the changes to the running configuration and close the dialog.
7. Click **Cancel** to close the dialog without committing updates to the running configuration.

6.8.1.2 Adding a New Transform Set

A transform set represents a combination of security protocols and algorithms. During the IPSec security association negotiation, peers agree to use a particular transform set for protecting data flow. If the attributes of an existing transform set no longer lend themselves useful, and an existing transform set is not required, create a new transform set to meet the needs of your network.

To edit the attributes of an existing transform set:

1. Select **Security** > **IPSec VPN** from the main menu tree.
2. Click the **Configuration** tab.
3. Click the **Add** button.



4. Define the following information as required for the new transform set.

Name	Create a name describing this new transform set.
AH Authentication Scheme	Select the **Use AH** checkbox to define the AH Transform Authentication scheme. Options include: • *None* - No AH authentication is used. • *AH-MD5-HMAC* - AH with the MD5 (HMAC variant) authentication algorithm. • *AH-SHA-HMAC* - AH with the SHA (HMAC variant) authentication algorithm.

ESP Encryption Scheme	Select the **Use ESP** checkbox to define the ESP Encryption Scheme. Options include: • *None* - No ESP encryption is used with the transform set. • *ESP-DES* - ESP with the 56-bit DES encryption algorithm. • *ESP-3DES* - ESP with 3DES, ESP with AES. • *ESP-AES* - ESP with 3DES, ESP with AES (128 bit key). • *ESP-AES 192* - ESP with 3DES, ESP with AES (192 bit key). • *ESP-AES 256*- ESP with 3DES, ESP with AES (256 bit key).
ESP Authentication Scheme	Select the **Use ESP** checkbox to define the ESP Authentication Scheme. Options include: • *None* - No ESP authentication is used with the transform set. • *MD5-HMAC* - AH with the MD5 (HMAC variant) authentication algorithm. • *SHA-HMAC* - AH with the SHA (HMAC variant) authentication algorithm.
Mode	Define the current mode used with the transform set. The mode is either Tunnel or Transport.

5. Refer to the **Status** field for the current state of the requests made from applet. This field displays error messages if something goes wrong in the transaction between the applet and the switch.
6. Click **OK** to use the changes to the running configuration and close the dialog.
7. Click **Cancel** to close the dialog without committing updates to the running configuration.

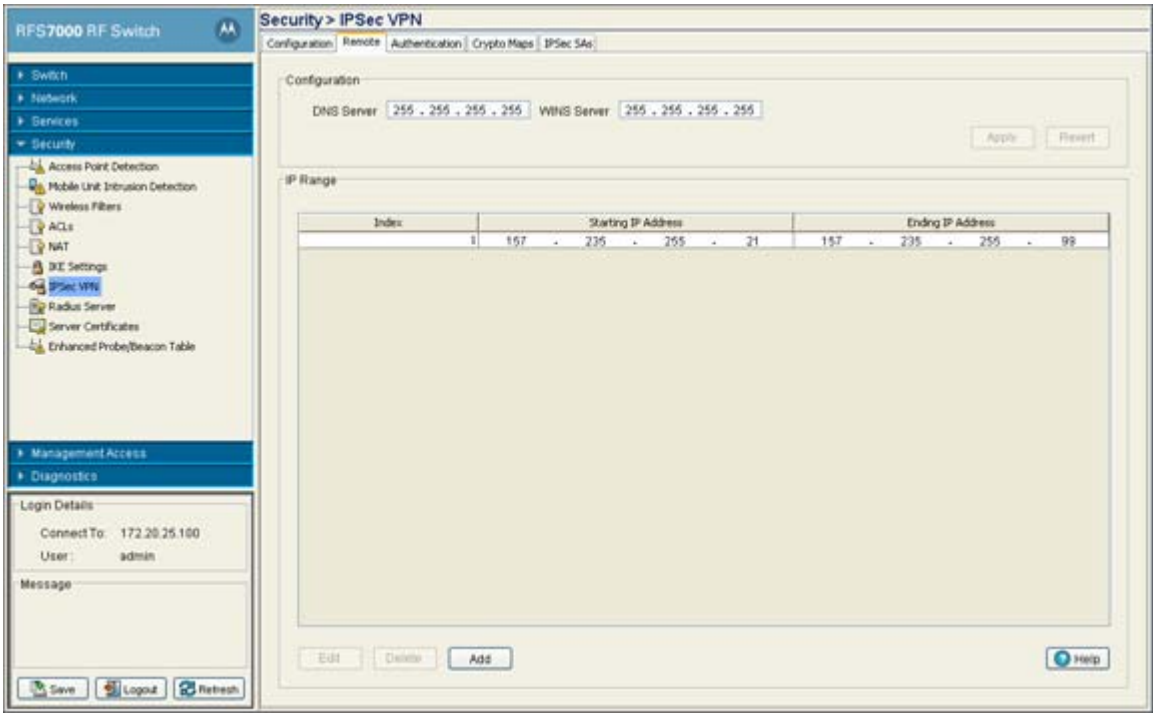
6.8.2 Defining the IPSec VPN Remote Configuration

Use the **IPSec VPN Remote** tab to configure the DNS and/or WINS Servers used to route packets to the remote end of the IPSec VPN tunnel. The Remote tab is also used for defining the IP address range used within the IPSec VPN tunnel and configuring the authentication scheme for user permissions within the IPSec VPN tunnel.

To define the IPSEc VPN remote configuration:

1. Select **Security** > **IPSec VPN** from the main menu tree.

2. Click the **Remote** tab.



3. Refer to the **Configuration** field to define the following:

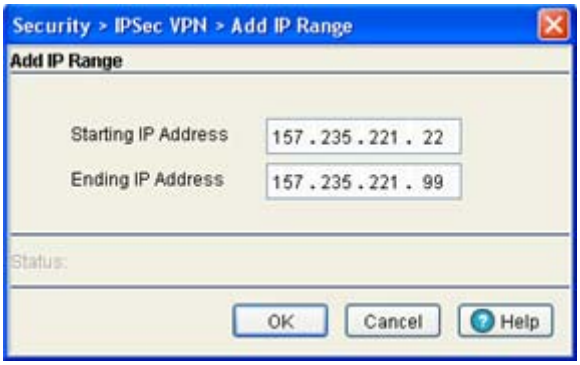
DNS Server	Enter the numerical IP address of the DNS Server used to route information to the remote destination of the IPSec VPN.
WINS Server	Enter the numerical IP address of the WINS Server used to route information to the remote destination of the IPSec VPN.
Apply	Click **Apply** to save any updates made to the screen.
Revert	Click the **Revert** button to disregard changes and revert back to the last saved configuration.

4. Click the **IP Range** tab to view the following:

Index	Enter the index assigned to the range of IP addresses displayed in the Starting and Ending IP Address ranges. This index is used to differentiate the index from others with similar IP addresses.
Starting IP Address	Enter the numerical IP address used as the starting address for the range defined. If the Ending IP address is left blank, only the starting address is used for the remote destination.
Ending IP Address	Enter a numerical IP address to complete the range. If the Ending IP address is blank, only the starting address is used as the destination address.

5. Click the **Edit** button (within the IP Range tab) to modify the range of existing IP addresses displayed.
6. Select an IP address range index and click the **Delete** button to remove this range from those available within the IP Range tab.

7. To add a new range of IP addresses, click the **Add** button (within the IP Range tab) and define the range in the fields provided. Click **OK** when completed to save the changes.



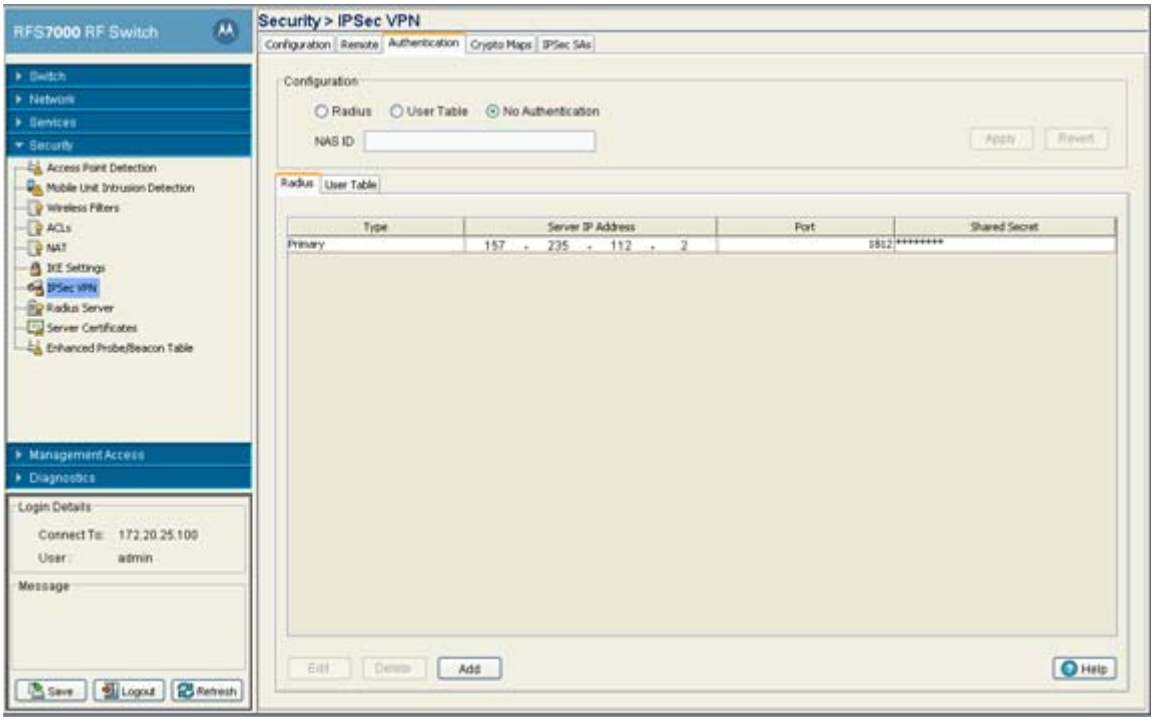
8. Click **Cancel** to disregard the changes and revert to the last saved configuration.

6.8.3 Configuring IPSEC VPN Authentication

If IKE is not used for establishing security associations, there is no negotiation of security associations. Consequently, the configuration information in both systems must be the same for traffic to be processed successfully by the IPSec resource. Select the **Authentication** tab to define the credential verification mechanisms used with the IPSEC VPN configuration.

To define the IPSEc VPN authentication configuration:

1. Select **Security** > **IPSec VPN** from the main menu tree.
2. Select the **Authentication** tab.



3. Define whether IPSec VPN user authentication is conducted using a Radius Server (by selecting the **Radius** radio button), by a user-defined set of names and password (by selecting the **User Table**

radio button) or if no authentication is used for credential verification (by selecting the **No Authentication** radio button).

4. Enter a **NAS ID** for the NAS port.

   The profile database on the Radius server consists of user profiles for each physical *network access server* (NAS) port connected. Every profile contains a profile matched to a username representing a physical port. When the switch authorizes users, it queries the user profile database using a username representative of the physical NAS port making the connection.

5. If the **Radius Server** radio button was selected, the following server information displays when the Radius tab is selected:

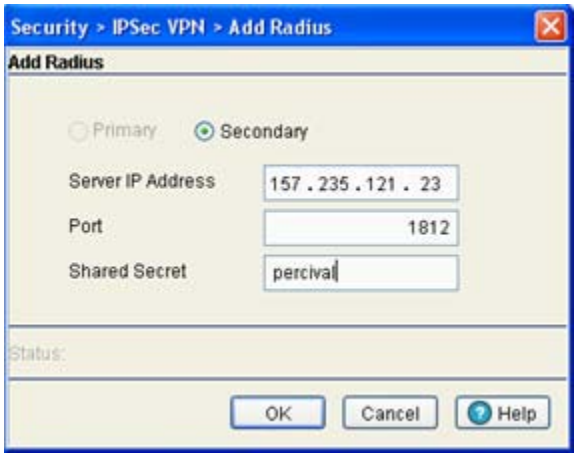
Type	Displays whether this target server is a Primary or Secondary Radius Server.
Server IP Address	Displays the IP address of the server acting as the data source for the Radius server.
Port	Displays the TCP/IP port number for the server acting as a data source for the Radius. The default port is 1812.
Shared Secret	Displays a shared secret used for each host or subnet authenticating against the Radius server. The shared secret can be up to 7 characters in length.

6. Select an existing Radius Server and click the **Edit** button to modify its designation as a primary or secondary Radius Server, IP address, port, NAS ID and shared secret password.

   Motorola recommends only modifying an existing Radius Server when its current configuration is no longer viable for providing user authentication. Otherwise, define a new Radius Server.

7. Select an existing server and click the **Delete** button to remove it from list of available Radius Servers for the remote VPN connection. Only delete a server if its configuration does not provide a valid authentication medium.

8. If you require a new Radius Server be configured, click the **Add** button.



   Set this server's designation as a primary or secondary Radius Server (using the checkboxes), define the server IP address, port and shared secret password. Click **OK** when completed to save the changes.

9. If the **User Table** checkbox was selected from within the Configuration field, select the User Table tab to review the User Name and Passwords defined for use.

10. Click the **Add** button to display a screen used to add a new User and Password. Enter a User Name and Password and confirm. Click **OK** to save the changes.

11. To change an existing user's password, select the user from within the User Table and click the **Change Password** button. Change and confirm the updated password.
12. If necessary, select an existing user and click the **Delete** button to remove that user from the list available within the User Table.

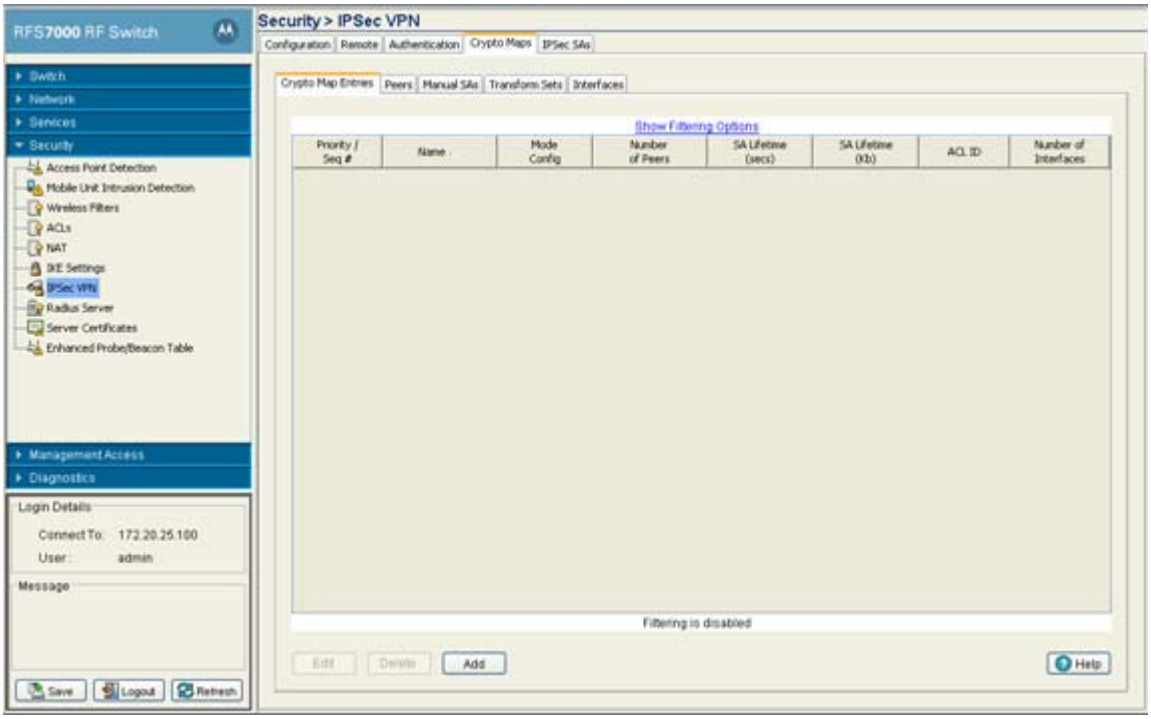
6.8.4 Configuring Crypto Maps

Crypto Maps allow you to set restrictions preventing peers with specific certificates (especially certificates with particular DNs) from accessing selected encrypted interfaces. If restricting access, specify a fewer number of Crypto Maps (referring to large identity sections) instead of specifying a large number of Crypto Maps (referring to small identity sections).

To define the Crypto Map configuration:

1. Select **Security** > **IPSec VPN** from the main menu tree.

2. Click the **Crypto Maps** tab.



The Crypto Maps screen is divided into 5 tabs, each serving a different function in the overall Crypto Map configuration. Refer to the following:

- *Crypto Map Entries*
- *Crypto Map Peers*
- *Crypto Map Manual SAs*
- *Crypto Map Transform Sets*
- *Crypto Map Interfaces*

6.8.4.1 Crypto Map Entries

To review, revise or add Crypto Map entries:

1. Select **Security** > **IPSec VPN** from the main menu tree.
2. Click the **Crypto Maps** tab and select **Crypto Map Entries**.
3. Review the following Crypto Map attributes to determine if an existing Crypto Map requires revision, deletion or if a new Crypto Map needs to be created.

Priority / Seq	Displays the numerical priority assigned to each Crypto Map.
Name	Displays the user-assigned name for this specific Crypto Map. This name can be modified using the **Edit** function or a new Crypto Map can be created by clicking the **Add** button.
Mode Config	Displays a green checkmark for the Crypto Map used with the current interface. A "X" is displayed next to other Crypto Maps not currently being used.

Number of Peers	Displays the number of peers used by each Crypto Map displayed.
SA Lifetime (secs)	Displays a SA Lifetime (in seconds) that forces the periodical expiration and re-negotiation of peer credentials. Thus, continually validating the peer relationship.
SA Lifetime (Kb)	Causes the security association to time out after the specified amount of traffic (in kilobytes) has passed through the IPSec tunnel (using the security association).
ACL ID	Displays the name of the ACL ID used for each Crypto Map.
Number of Interfaces	Displays the number of interfaces each specific Crypto Map is used with.

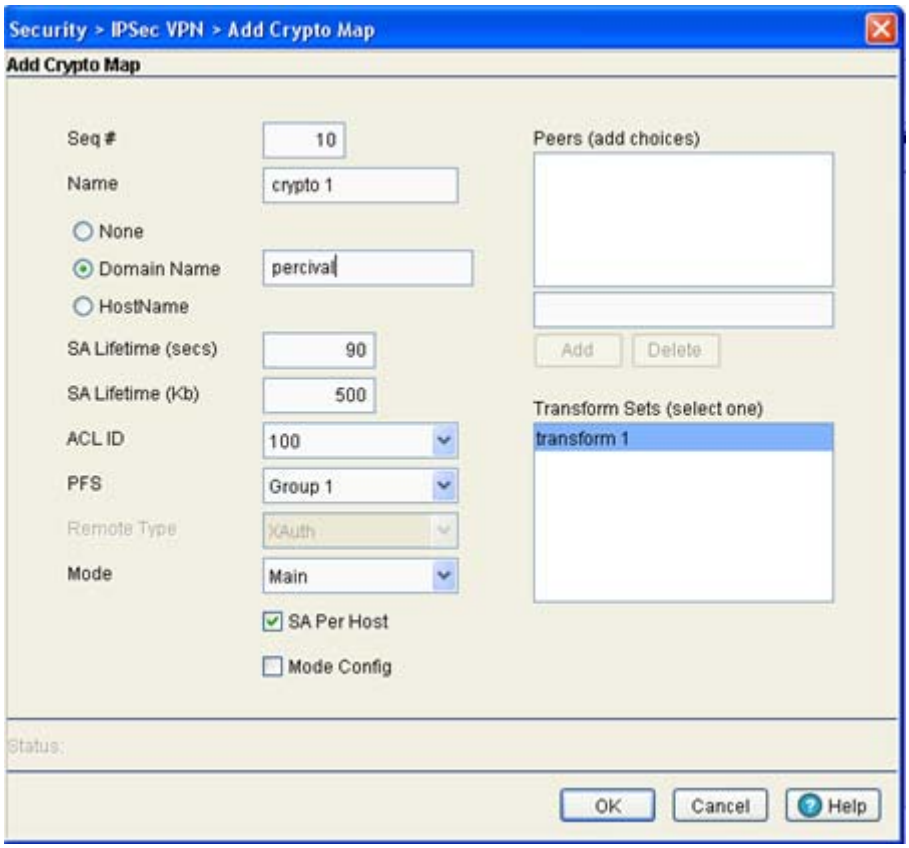
4. Select an existing Crypto Map and click the **Edit** button to modify the Crypto Map's attributes.

   If an entire Crypto Map requires revision, consider deleting the Crypto Map and creating a new one using the **Add** function.

   Refer to the definitions supplied for the **Add Crypto Map** screen (on the next page) to ascertain the requirements for editing a Crypto Map.

5. Select an existing Crypto Map and click the **Delete** button to remove it from the list of available Crypto Maps within the screen.

6. Click the **Add** button to define the attributes of a new Crypto Map.



   a. Assign a **Seq #** (sequence number) to distinguish one Crypto Map from the another.

   b. Assign the Crypto Map a **Name** to differentiate from others with similar configurations.

c. Use the **None, Domain Name** or **Host Name** radio buttons to select and enter the fully qualified domain or host name of the host exchanging identity information.

d. Define a **SA Lifetime (secs)** to define an interval (in seconds) that (when expired) forces a new association negotiation.

e. Define a **SA Lifetime (Kb)** to time out the security association after the specified amount of traffic (in kilobytes) has passed through the IPSec tunnel using the security association.

f. Use the **ACL ID** drop-down menu to permit a Crypto Map data flow using the permissions within the selected ACL.

g. Use the **PFS** drop-down menu to specify a group to require *perfect forward secrecy* (PFS) in requests received from the peer.

h. Use the **Remote Type** drop-down menu to specify a remote type of either **XAuth** or **L2TP**.

i. Use the **Mode** drop-down menu to specify a mode of **Main** or **Aggressive**. Aggressive mode enables you to configure pre-shared keys as Radius tunnel attributes for IP Security (IPSec) peers.

j. Optionally select the **SA Per Host** checkbox to specify that separate IPSec SAs should be requested for each source/destination host pair.

k. Optionally select the **Mode Config** checkbox to allow the new Crypto Map to be implemented using the aggressive mode (if selected from the Mode drop-down menu).

l. Refer to the **Peers (add choices)** field to select and use the Add and Delete buttons as necessary to add or remove existing peers to the Crypto Map. For information on adding or modifying peers, see *Crypto Map Peers on page 6-62*.

m. Refer to the **Transform Sets (select one)** field to select and assign a transform set for v with Crypto Map. Again, a transform set represents a combination of security protocols and algorithms. During the IPSec security association negotiation, peers agree to use a particular transform set for protecting data flow.

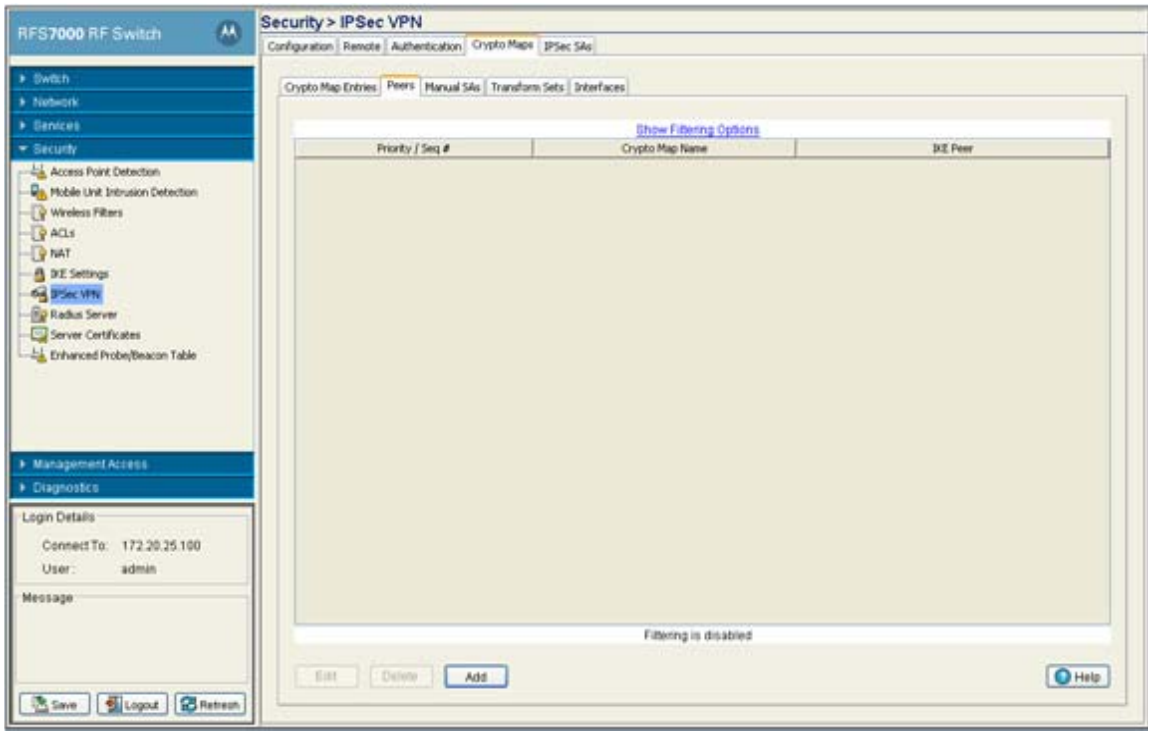
7. Click **OK** to save the new Crypto Map and display it within the Crypto Map tab.

6.8.4.2 Crypto Map Peers

To review, revise or add Crypto Map peers:

1. Select **Security** > **IPSec VPN** from the main menu tree.

2. Click the **Crypto Maps** tab and select **Peers**.



3. Refer to the read-only information displayed within the **Peers** tab to determine whether a peer configuration (among those listed) requires modification or a new peer requires creation.

Priority / Seq #	Displays each peer's Seq # (sequence number) to distinguish one from the other.
Crypto Map Name	Displays the name assigned to the peer to differentiate it from others with similar configurations.
IKE Peer	Displays the IKE peer used with the Crypto Map to build an IPSec security association.

4. If a Crypto Map Seq # or IKE peer requires revision, select it from amongst those displayed and click the **Edit** button.
5. Select an existing Crypto Map and click the **Delete** button to remove it from the list of those available to the switch.

6. If a new peer requires creation, click the **Add** button.

   a. Define the **Seq # /Name** for the new peer.

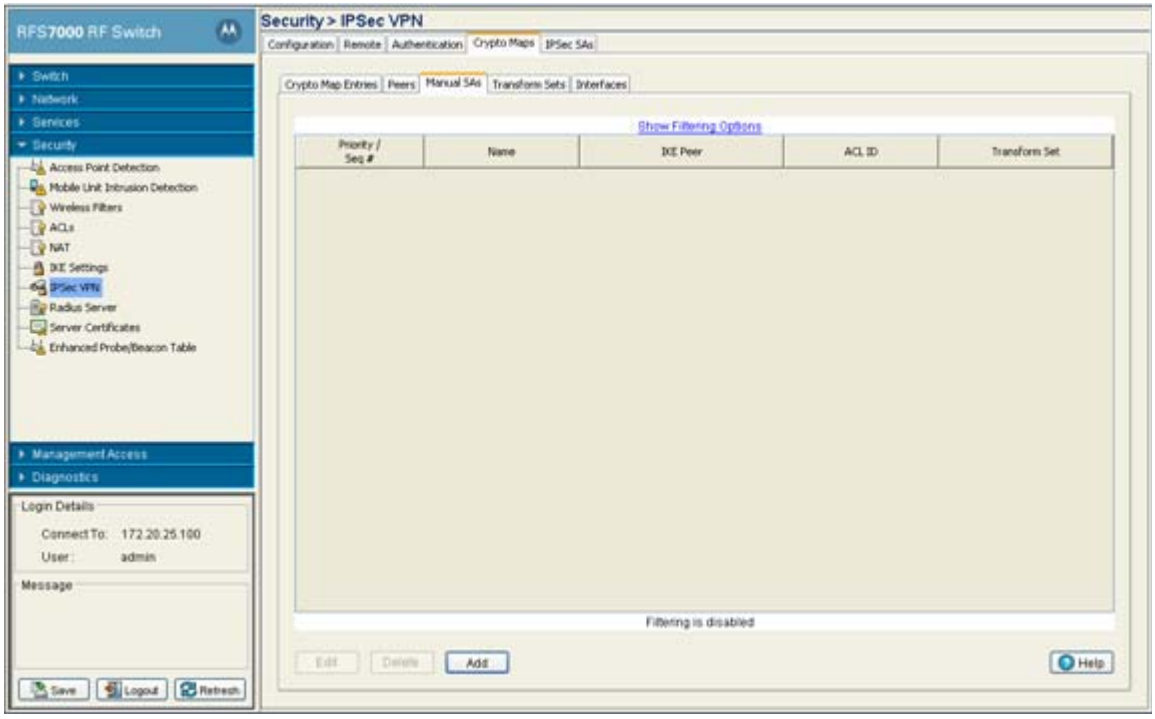
   b. Enter the name of the **IKE Peer** used with the Crypto Map to build an IPSec security association.

7. Click **OK** when completed to save the configuration of the new Crypto Map peer.

6.8.4.3 Crypto Map Manual SAs

To review, revise or add a Crypto Map using a manually defined security association:

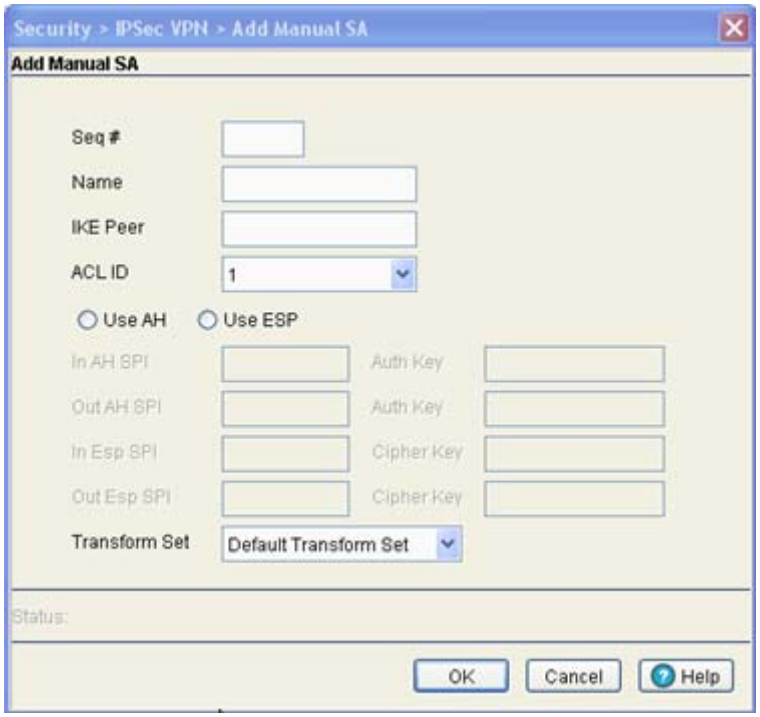
1. Select **Security** > **IPSec VPN** from the main menu tree.
2. Click the **Crypto Maps** tab and select **Manual SAs**.



3. Refer to the read-only information displayed within the **Manual SAs** tab to determine whether a Crypto Map with a manually defined security association requires modification or a new one requires creation.

Priority / Seq #	Displays the Seq # (sequence number) used to determine priority. The lower the number, the higher the priority.
Name	Displays the name assigned to the security association.
IKE Peer	Displays the IKE peer used with the Crypto Map to build an IPSec security association.
ACL ID	Displays the ACL ID the Crypto Map's data flow is using to establish access permissions.
Transform Set	Displays the transform set representing a combination of security protocols and algorithms. During the IPSec security association negotiation, peers agree to use a particular transform set for protecting the data flow.

4. If a Crypto Map with a manual security association requires revision, select it from amongst those displayed and click the **Edit** button to revise its Seq #, IKE Peer, ACL ID and security protocol.
5. Select an existing table entry and click the **Delete** button to remove it from the list of those available to the switch.
6. If a new Crypto Map manual security association requires creation, click the **Add** button.



   a. Define the **Seq #**. The sequence number determines priority among Crypto Maps. The lower the number, the higher the priority.

   b. Provide a unique **Name** for this Crypto Map to differentiate it from others with similar configurations.

   c. Enter the name of the **IKE Peer** used to build an IPSec security association.

d. Use the **ACL ID** drop-down menu to permit a Crypto Map data flow using the permissions within the selected ACL.

e. Select either the **AH** or **ESP** radio button to define whether the Crypto Map's manual security association is an *AH Transform Authentication* scheme or an *ESP Encryption Transform* scheme. The AH SPI *or* ESP SPI fields and key fields become enabled depending on which radio button is selected.

f. Define the **In AH SPI** and **Auth Keys** *or* **In Esp** and **Cipher Keys** depending on which option has been selected.

g. Use the **Transform Set** drop-down menu to select the transform set representing a combination of security protocols and algorithms. During the IPSec security association negotiation, peers agree to use the transform set for protecting the data flow. A new manual security association cannot be generated without the selection of a transform set. A default transform set is available if none are defined.

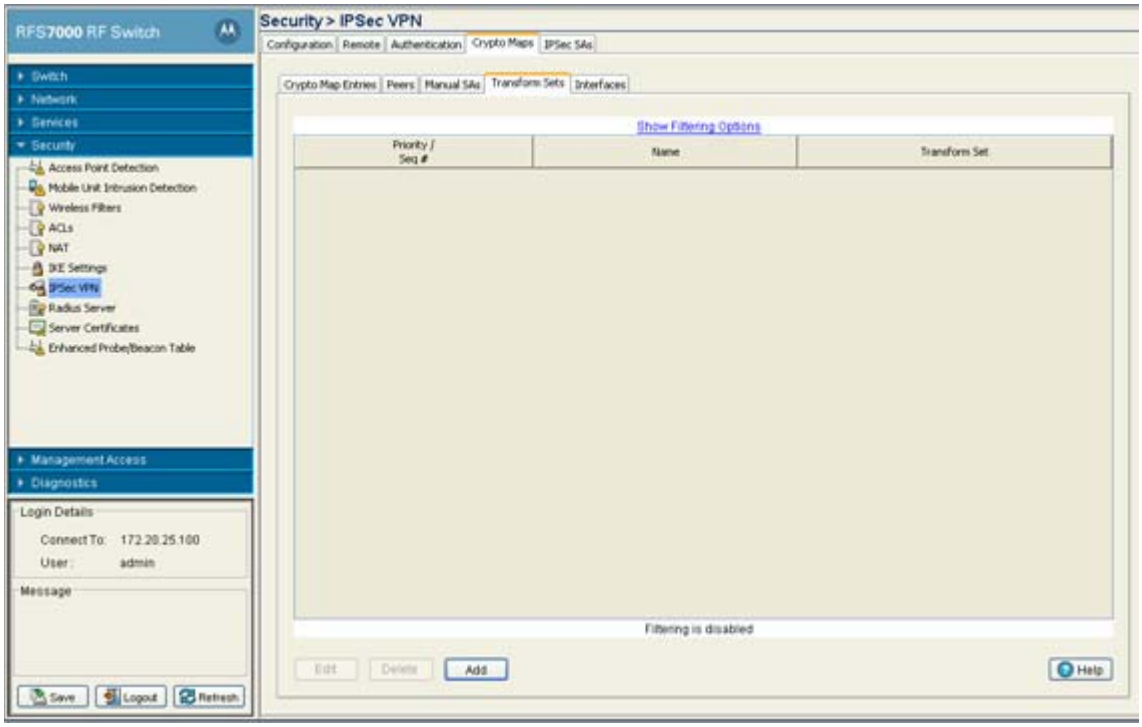
7. Click **OK** when completed to save the configuration of the Crypto Map security association.

6.8.4.4 Crypto Map Transform Sets

A transform set is a combination of security protocols and algorithms that define how the switch protects data.

To review, revise or add a Crypto Map transform set:

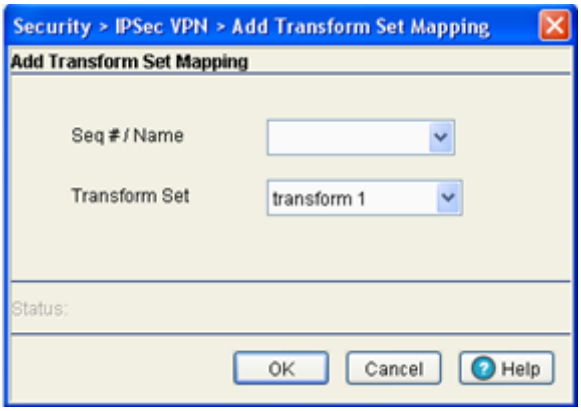
1. Select **Security** > **IPSec VPN** from the main menu tree.
2. Click the **Crypto Maps** tab and select **Transform Sets**.



3. Refer to the read-only information displayed within the **Transform Sets** tab to determine whether a Crypto Map transform set requires modification or a new one requires creation.

Priority / Seq #	Displays the Seq # (sequence number) used to determine priority.
Name	Displays the name assigned to the Crypto Map that's using the transform set.
Transform Set	Displays the transform set representing a combination of security protocols and algorithms. During the IPSec security association negotiation, peers agree to use the transform set for protecting the data flow.

4. Select an existing Crypto Map and click the **Edit** button to revise its Seq #, Name and Transform Set.
5. Select an existing entry from the table and click the **Delete** button to remove from list.
6. If a new Crypto Map transform set requires creation, click the **Add** button.



   a. Define the **Seq #/Name**. The lower the number, the higher the priority among Crypto Maps.

   b. Enter the name of the **Transform set** used with the Crypto Map.

7. Click **OK** when completed to save the configuration of the Crypto Map transform set.

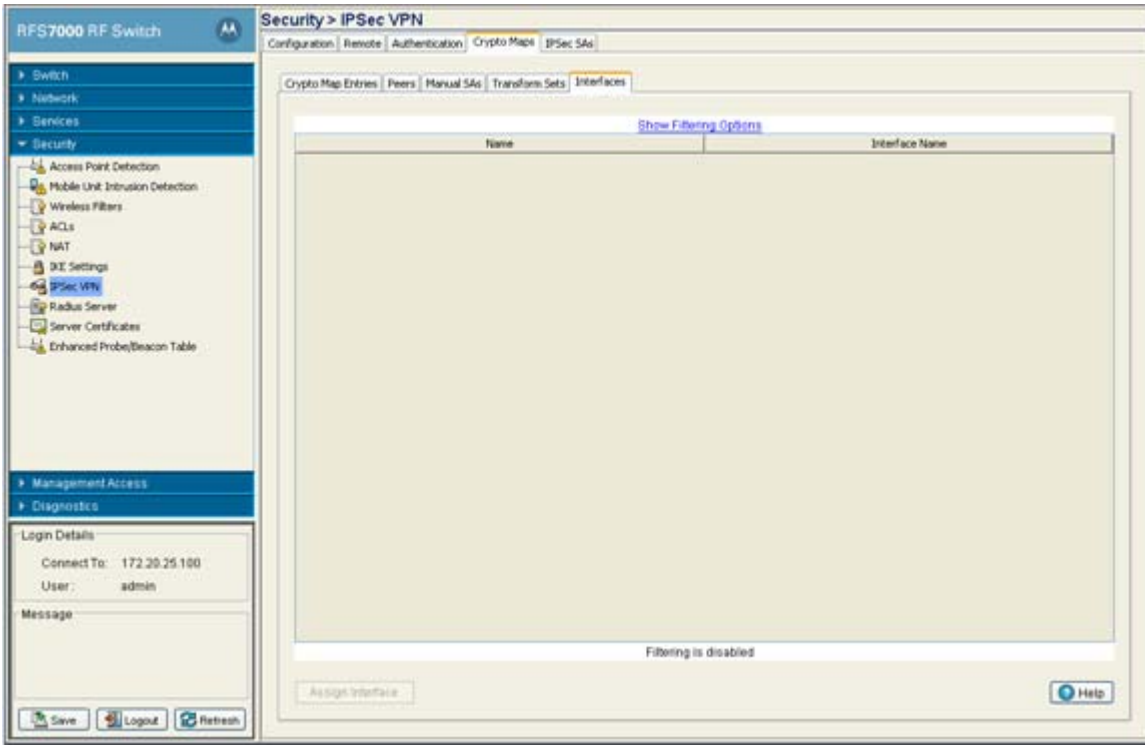
6.8.4.5 Crypto Map Interfaces

To review the interfaces currently available to the Crypto Maps or assign an interface:

NOTE: A Crypto Map cannot get applied to more than one interface at a time. To apply the same Crypto Map settings to multiple interfaces, create a unique Crypto Map for each interface.

1. Select **Security** > **IPSec VPN** from the main menu tree.

2. Click the **Crypto Maps** tab and select **Interfaces**.



3. Refer to the following read-only information displayed within the **Interfaces** tab.

Name	Lists the name of the Crypto Maps available for the interface.
Interface Name	Displays the name of the interface through which IPSec traffic flows. Applying the Crypto Map set to an interface instructs the switch to evaluate all the interface's traffic against the Crypto Map set and to use the specified policy during connection or security association negotiation on behalf of traffic protected by crypto (either CET or IPSec).

4. Click the **Assign Interface** button to assign a Crypto Map to each interface through which IPSec traffic flows.

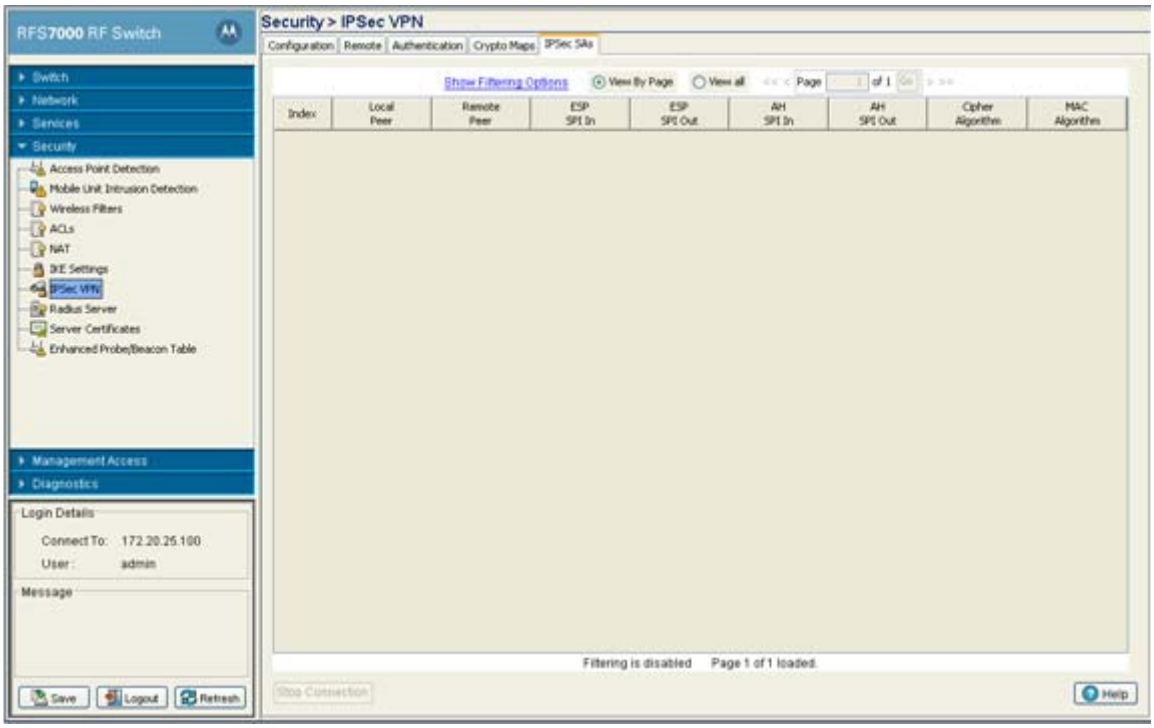
   Assigning the Crypto Map set to an interface instructs the security appliance to evaluate all the traffic against the Crypto Map set and use the specified policy during connection or SA negotiation. Assigning a Crypto Map to an interface also initializes run-time data structures (such as the SA database and the security policy database). Reassigning a modified Crypto Map to the interface resynchronizes the run-time data structures with the Crypto Map configuration. Also, adding new peers through the new sequence numbers and reassigning the Crypto Map does not break existing connections.

6.8.5 Viewing IPSec Security Associations

Refer to the **IPSec SAs** tab to review the various *security associations* (SAs) between the local and remote peers comprising an IPSec VPN connection. The IPSec SA tab also displays the authentication and encryption schemes used between the VPN peers as well other device address information.

To display IPSec VPN security associations:

1. Select **Security** > **IPSec VPN** from the main menu tree.
2. Click the **IPSec SAs** tab.



3. Refer to the following security association data:

Index	Displays the numerical (if defined) ID for the security association. Use the index to differentiate the index from others with similar configurations.
Local Peer	Displays the name of the local peer at the near side of the VPN connection.
Remote Peer	Displays the name of the remote peer at the far side of the VPN connection.
ESP SPI In	SPI specified in the *Encapsulating Security Payload* (ESP) inbound header.
ESP SPI Out	SPI specified in the *Encapsulating Security Payload* (ESP) outbound header.
AH SPI In	Displays the inbound *Authentication Header* (AH).
AH SPI Out	Displays the outbound *Authentication Header* (AH).
Cipher Algorithm	Displays the algorithm used with the ESP cipher.
MAC Algorithm	Displays the algorithm used with the security association.

4. Use the page navigation facility (found on top of the table next to the **Show Filtering Options** link) to view the list of security associations.

The switch can display a maximum of 600 security associations. To enable a search through the list, the *Security > IPSec VPN* screen provides a page navigation facility. Up to 30 security associations display per page.

The following navigation and pagination options are available:

View All	Use this option to view all the SAs in one screen. When selected, all the SAs are displayed in the same screen.
View By Page	Use this option to split the SA list into pages and view them one page at a time.

The following controls are enabled when the **View By Page** option is selected.

<<	Use this control to navigate to the first page.
<	Use this control to navigate to the previous page.
Page	Use this text box to enter the page number to jump directly to. This value cannot exceed the total number of pages.
Go	Use the Go button to jump to the page specified in the Page text box.
>	Use this control to navigate to the next page.
>>	Use this control to navigate to the last page.

If necessary, select a security association from those displayed and click the **Stop Connection** button to stop the security association.

6.9 Configuring the Radius Server

Remote Authentication Dial-In User Service (Radius) is a client/server protocol and software enabling remote access servers to communicate with the switch to authenticate users and authorize their access to the switch managed network. For an overview on the switch's Radius deployment, see *Radius Overview on page 6-71*.

Setting up Radius on the switch entails the following configuration activities:

- *Defining the Radius Configuration*
- *Configuring Radius Authentication and Accounting*
- *Configuring Radius Users*
- *Configuring Radius User Groups*
- *Viewing Radius Accounting Logs*

NOTE For hotspot deployment, Motorola recommends using the switch's onboard Radius server and built-in user database. This is the easiest setup option and offers a high degree of security and accountability.

6.9.1 Radius Overview

Radius enables centralized management of switch authentication data (usernames and passwords). When a MU attempts to associate to the Radius supported switch, the switch sends the authentication request to the Radius server. The communications between the switch and server are authenticated and encrypted through the use of a shared secret password (not transmitted over the network).

The switch's local Radius server stores the authentication data locally, but can also be configured to use a remote user database. A Radius server as the centralized authentication server is an excellent choice for performing accounting. Radius can significantly increase security by centralizing password management.

NOTE The switch can be configured to use its own local Radius server or an external Radius server you define and configure. For information on the benefits and risks of using the switch's resident Radius Server as opposed to an external Radius Server, see *Using the Switch's Radius Server Versus an External Radius Server on page 6-73*.

CAUTION When restarting or rebooting the switch, the Radius server is restarted regardless of its state before the reboot.

The Radius server defines authentication and authorization schemes for granting the access to wireless clients. Radius is also used for authenticating hotspot and remote VPN Xauth. The switch can be configured to use 802.1x EAP for authenticating wireless clients with a Radius server. The following EAP authentication types are supported by the switch's onboard Radius server:

- *TLS*
- *TTLS and MD5*
- *TTLS and PAP*
- *TTLS and MSCHAPv2*

- *PEAP and GTC*
- *PEAP and MSCHAPv2*

Apart from EAP authentication, the switch allows the enforcement of user-based policies. User-based policies include dynamic VLAN assignment and access based on time of day.

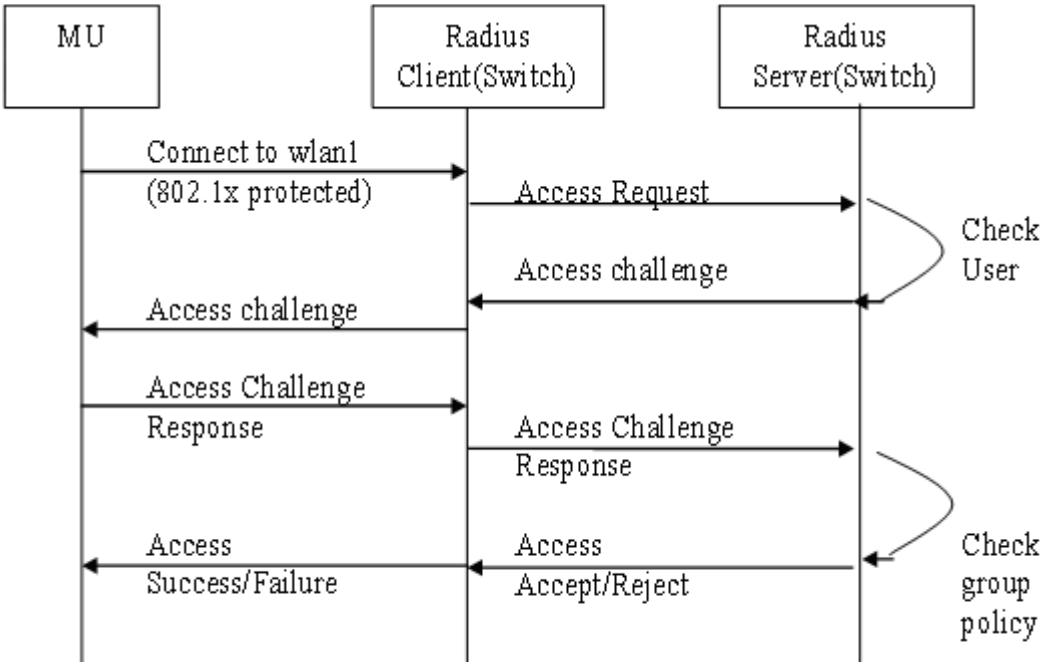
The switch uses a default trustpoint. A certificate is required for EAP TTLS,PEAP and TLS Radius authentication (configured with the Radius service).

Dynamic VLAN assignment is achieved based on the Radius server response. A user who associates to WLAN1 (mapped to VLAN1) can be assigned a different VLAN after authentication with the Radius server. This dynamic VLAN assignment overrides the WLAN's VLAN ID to which the User associates.

NOTE For a Radius supported VLAN to function properly, the "Dynamic Assignment" checkbox must be enabled for the WLAN supporting the VLAN. For more information, see *Editing the WLAN Configuration on page 4-27*.

For 802.1x EAP authentication, the switch initiates the authentication process by sending an EAPoL message to the access port only after the wireless client joins the wireless network. The Radius client in the switch processes the EAP messages it receives. It encapsulates them to Radius access requests and sends them to the configured Radius server (in this case the switch's local Radius server).

The Radius server validates the user's credentials and the challenge information received in the Radius access request frames. If the user is authorized and authenticated, the wireless client is granted access by sending a Radius access accept frame. This is transmitted to the wireless client in an EAPoL frame format.



6.9.1.1 User Database

The User Group names and the associated users in each group can be created in the local database. The User ID in the received access request is mapped to the associated wireless group for authentication.

The switch supports the creation of 500 users and 100 groups on its local database. Each group can have a maximum of 500 users configured.

6.9.1.2 Authentication of Terminal/Management User(s)

The local Radius server can be used to authenticate users. A normal user (with a password) should be created in the local database. These users should not be a part of any group.

6.9.1.3 Access Policy

Access policies are defined for a group created in the local database. Each user is authorized based on the access policies defined for the groups to which the user belongs. Access policies allow the administrator to control access to a set of users based on the WLANs (ESSID).

Group to WLAN access is controlled using a "Time of the day" access policy.

Consider User1 (part of Group 1), which is mapped to WLAN1 (ESSID of WLAN1). When the user tries to connect to WLAN1, the user is prompted to enter his/her credentials. Once the authentication and authorization phases are successful, only User1 is able to access WLAN1 for the allowed duration (but not any other WLAN). Each user group can be configured to be a part of one VLAN. All the users in that group are assigned the same VLAN ID if dynamic VLAN authorization has been enabled on the WLAN.

6.9.1.4 Proxy to External Radius Server

Proxy realms are configured on the switch, which has the details of the external Radius server to which the corresponding realm users are to be proxied. The obtained user ID is parsed in a (user@realm, realm/user, user%realm, user/realm) format to determine which proxy Radius server is to be used.

6.9.1.5 LDAP

An external data source based on LDAP can be used to authorize users. The Radius server looks for user credentials in the configured external LDAP server and authorizes users. The switch supports two LDAP server configurations.

6.9.1.6 Accounting

Accounting should be initiated by the Radius client. Once the Local/Onboard Radius server is started, it will listen for both authentication and accounting records.

6.9.2 Using the Switch's Radius Server Versus an External Radius Server

The switch ships with a default configuration defining the local Radius Server as the primary authentication source (default users are admin with superuser privileges and operator with monitor privileges). No secondary authentication source is specified. However, Motorola recommends using an external Radius Server as the primary user authentication source and the local switch Radius Server as the secondary user authentication source. For information on configuring an external Radius Server, see *Configuring External Radius Server Support on page 4-43*. To continue to instructions on how to configure the switch's local Radius Server, see *Defining the Radius Configuration on page 6-74*.

If an external Radius server is configured as the switch's primary user authentication source and the switch's local Radius Server is defined as an alternate method, the switch first tries to authenticate users using the external Radius Server. If an external Radius Server is unreachable, the switch reverts to the local Server's user database to authenticate users. However, if the external Radius server is reachable but rejects the user or if the user is not found in the external Server's database, the switch will not revert to the local Radius Server and the authentication attempt fails.

If the switch's local Radius Server is configured as the primary authentication method and an external Radius Server is configured as an alternate method, the alternate external Radius Server will not be used as an

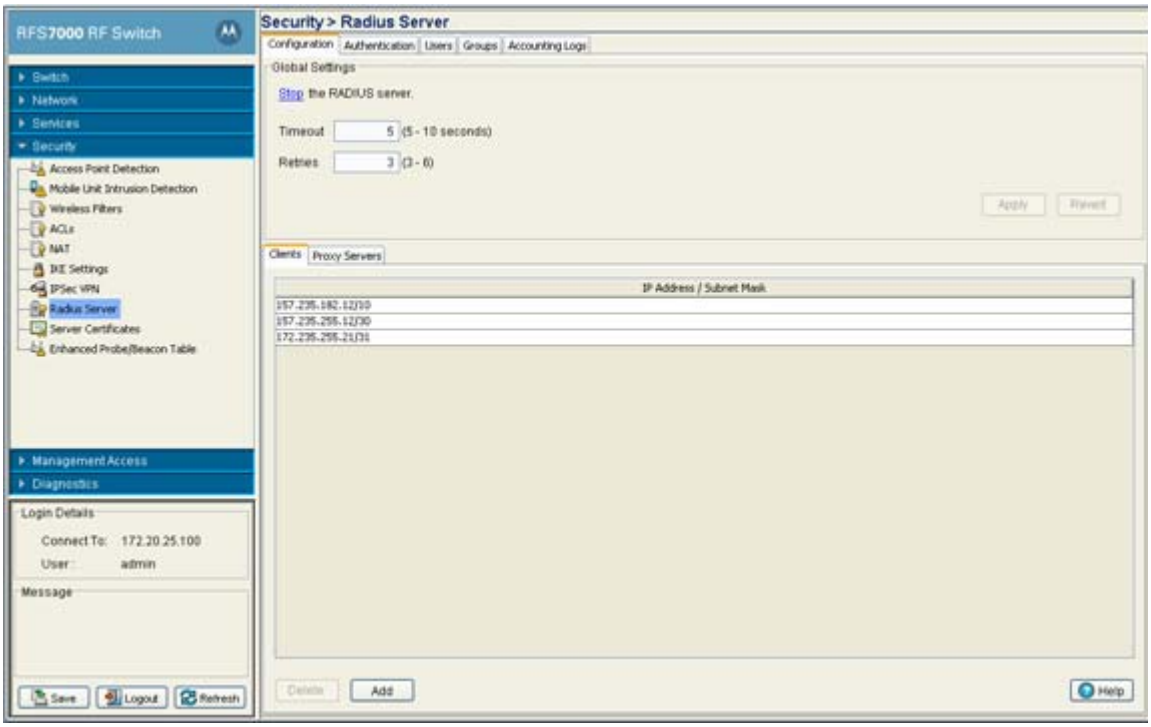
authentication source if a user does not exist in the local Server's database, since the primary method has rejected the authentication attempt.

For instructions on configuring an external Radius Server, as well as defining Radius Server settings specific for use with an RFS7000 model switch, see *Configuring External Radius Server Support on page 4-43*.

6.9.3 Defining the Radius Configuration

To configure Radius support on the switch:

1. Select **Security** > **Radius Server** from the main menu.
2. Ensure the **Configuration** tab is selected.



3. Click the Start **the RADIUS server** link to use the switch's own Radius server to authenticate users accessing the switch managed network.
4. Set a **Timeout** value (between 5 and 10 seconds) to define the timeout interval for the proxy request. This value represents the time to wait for a reply from the proxy server.

   Ensure the value is set long enough to compensate for the heaviest periods of data traffic within the switch managed network.
5. Set a **Retires** value (between 3 and 6) to define the number of retries sent to proxy server before giving up the request.
6. Click the **Apply** button to save the changes made to within the Global Settings field.

7. Click the **Revert** button to cancel any changes made within the Global Settings field and revert back to the last saved configuration.

NOTE The appearance of the bottom portion of the Configuration tab differs depending on whether **Clients** or **Proxy Servers** is selected. Select the Clients tab to display the IP Address and Subnet Mask of existing Radius clients. Existing clients can be modified or new clients added. For more information, see *Radius Client Configuration on page 6-75*. Select the Proxy Servers tab to display the ID suffix, IP Address and Port Number of existing Radius proxy servers. Existing servers can be modified or new proxy servers added. For more information, see *Radius Proxy Server Configuration on page 6-76*.

6.9.3.1 Radius Client Configuration

A Radius client implements a client/server mechanism enabling the switch to communicate with a central server to authenticate users and authorize their access to the switch managed network. A Radius client is often an embedded device since it alleviates the need to store detailed user information locally.

To configure Radius client support:

1. Select **Security** > **Radius Server** from the main menu.
2. Ensure the **Configuration** tab is selected.
3. Select the **Clients** tab from the bottom portion of the Configuration tab.

   The Clients tab displays the IP address and subnet mask of the switch's existing Radius clients.
4. To remove an existing Radius client configuration from the table of configurations available to the switch, select the configuration and click the **Delete** button.
5. To create a new Radius client configuration, click the **Add** button at the bottom of the screen.

   a. Specify the **IP Address/Mask** of the subnet or host authenticating with the Radius client.
   b. Specify a Radius **Shared Secret** for authenticating the RADIUS client.

      Shared secrets used to verify Radius messages (with the exception of the Access-Request message) are sent by a Radius -enabled device configured with the same shared secret. The shared secret is a case-sensitive string that can include letters, numbers, or symbols. Make the shared secret at least 31 characters to protect the Radius server from brute-force attacks.
   c. Refer to the **Status** field for the current state of the requests made from applet. This field displays error messages if something is wrong in the transaction between the applet and the switch.
   d. Click **OK** to use the changes to the running configuration and close the dialog.
   e. Click **Cancel** to close the dialog without committing updates to the running configuration

6.9.3.2 Radius Proxy Server Configuration

The switch can send Radius requests to a properly configured proxy Radius server. A user's access request is sent to a proxy server if it cannot be authenticated by a local server. The switch forwards the access request to a proxy server that can authenticate the user based on the realm. The proxy server checks the information in the user access request and either accepts or rejects the request. If the proxy target server accepts the request, it returns configuration information specifying the type of connection service required to authenticate the user.

To configure Radius proxy server support:

1. Select **Security** > **Radius Server** from the main menu.
2. Ensure the **Configuration** tab is selected.
3. Select the **Proxy Servers** tab from the bottom of the Configuration tab.

   The Proxy Servers tab displays the user ID suffix (index), IP address and port number of the switch's existing proxy server configurations.
4. To remove an existing Radius proxy server configuration from the table of configurations available to the switch, select the configuration and click the **Delete** button.
5. To create a new Radius proxy server configuration, click the **Add** button at the bottom of the screen.

   a. Create a new **User ID Suffix** serving as an abbreviation for the configuration to differentiate it from other configurations with similar attributes.
   b. Specify the **IP Address** of the new Radius proxy server.
   c. Enter the TCP/IP port number for the port used by the proxy Radius server.
   d. Specify a Radius **Shared Secret** for authenticating the Radius client.

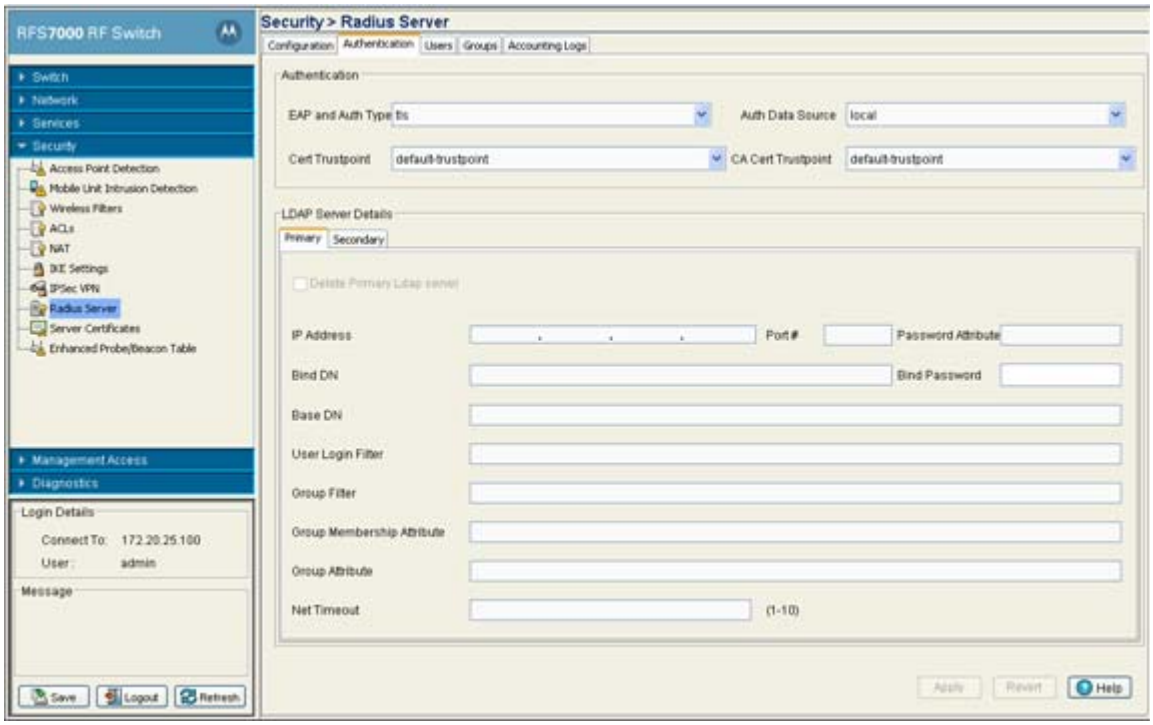
      The shared secret is used to verify Radius messages. It is a case-sensitive string that can include letters, numbers, or symbols. Make the shared secret at least 31 characters long to protect the Radius server from brute-force attacks.
   e. Refer to the **Status** field for the current state of the requests made from applet. This field displays error messages if something goes wrong in the transaction between the applet and the switch.
   f. Click **OK** to use the changes to the running configuration and close the dialog.
   g. Click **Cancel** to close the dialog without committing updates to the running configuration

6.9.4 Configuring Radius Authentication and Accounting

Deploy one or more Radius servers to configure user authentication, EAP type and the user database. Radius accounting supplies administrators with user data as Radius sessions are started and terminated.

To define the Radius authentication and accounting configuration:

1. Select **Security** > **Radius Server** from the main menu.
2. Select the **Authentication** tab.



3. Refer to the **Authentication** field to define the following Radius authentication information:

EAP and Auth Type Specify the EAP and Authentication type for the Radius server.

- PEAP uses a TLS layer on top of EAP as a carrier for other EAP switches. PEAP is an ideal choice for networks using legacy EAP authentication methods.
- TTLS is similar to EAP-TLS, but the client authentication portion of the protocol is not performed until after a secure transport tunnel has been established. This allows EAP-TTLS to protect legacy authentication methods used by some Radius servers.

Auth Data Source Use **Auth Data Source** drop-down menu to select the data source for the local Radius server.

- If **Local** is selected, the switch's internal user database serves as the data source for user authentication. Refer to the **Users** and **Groups** tabs to define user and group permissions for the switch's local Radius server.
- If **LDAP** is selected, the switch uses the data within an LDAP server.

Cert Trustpoint	Click the **View/Change** button to specify the trustpoint from which the Radius server automatically grants certificate enrollment requests. A trustpoint is a representation of a CA or identity pair. A trustpoint contains the identity of the CA, CA-specific configuration parameters, and an association with one enrolled identity certificate. If the server certificate trustpoint is not used, the default trustpoint is used instead.
CA Cert Trustpoint	Click the **View/Change** button to specify the CA certificate trustpoint from which the Radius server automatically grants certificate enrollment requests. A trustpoint is a representation of a CA or identity pair. A trustpoint contains the identity of the CA, CA-specific configuration parameters, and an association with one enrolled identity certificate. If a CA trustpoint is not specified, the "default trustpoint's CA certificate is used as a ca certificate. If the "Default trustpoint" does not have a CA certificate, the server certificate itself will be used as the CA certificate.

NOTE EAP-TLS will not work with a default trustpoint. Proper CA and Server trustpoints must be configured for EAP-TLS. For information on configuring certificates for use with the switch, see *Creating Server Certificates on page 6-86*.

4. Refer to the **LDAP Server Details** field to define the primary and secondary Radius LDAP server configuration providing access to an external database used with the local Radius server.

IP Address	Enter the IP address of the external LDAP server acting as the data source for the Radius server. This server must be accessible from an active subnet on the switch.
Port	Enter the TCP/IP port number for the LDAP server acting as the data source.
Password Attribute	Enter the password attribute used by the LDAP server for authentication.
Bind DN	Specify the distinguished name to bind with the LDAP server.
Bind Password	Enter a valid password for the LDAP server.
Base DN	Specify a distinguished name that establishes the base object for the search. The base object is the point in the LDAP tree at which to start searching.
User Login Filter	Enter the login used by the LDAP server for authentication.
Group Filter	Specify the group filters used by the LDAP server.
Group Membership Attribute	Specify the Group Member Attribute sent to the LDAP server when authenticating users.
Group Attribute	Specify the group attribute used by the LDAP server.
Net Timeout	Enter a timeout value the system uses to terminate the connection to the Radius Server if no activity is detected.

5. Click the **Apply** button to save the changes made to within the screen.

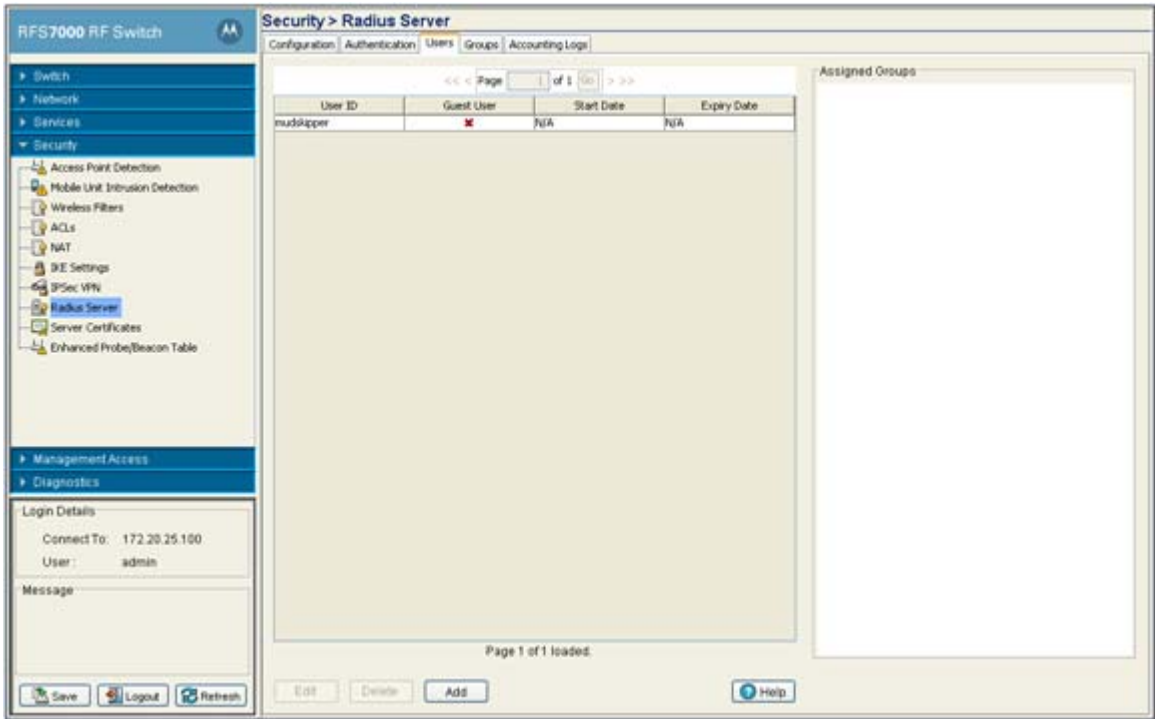
6. Click the **Revert** button to cancel any changes made within the screen and revert back to the last saved configuration.

6.9.5 Configuring Radius Users

Refer to the **Users** tab to view the current set of users and groups assigned for the Radius server. The Users tab is employed when **Local** is selected as the Auth Data Source within the **Authentication & Accounting** tab. The user information is ignored if an LDAP server is used for authentication.

To define the Radius user permissions for switch access:

1. Select **Security** > **Radius Server** from the main menu.
2. Select the **Users** tab.



3. Refer to the following user information to assess whether an existing user can be used with the local Radius server as is, requires modification or if a new user is required.

User ID	Displays the username for this specific user. The name assigned should reflect the user's identity and perhaps their status within the switch managed network (guest versus secure user).
Guest User	Displays whether a specific user has been defined as a guest user (with a red X) or has been configured as permanent user. Guest users have temporary Radius server access.
Start Date	Defines the time when Guest User's privileges commence.
Expiry Date	If the user has been assigned guest privileges, they were also assigned a date when their Radius privileges expire.

4. Refer to the **Available Groups** field to view the memberships for existing users.

If the group assignment is insufficient, use the **Edit** or **Add** functions to modify/create users or modify their existing group assignments. For guest users, only the password is editable. For normal (non-guest) users, the password and group association can be modified.

Modify the existing user's guest designation, password, expiry date and group assignments as required to reflect the user's current local Radius authentication requirements.

5. If an existing user is no longer needed, select the user from those displayed and click the **Delete** button to permanently remove the user from the list available.
6. To create a new user for the local Radius server, click the **Add** button and provide the following information.

CAUTION If password encryption is not enabled, Radius user passwords are stored in the running configuration file in clear text. The user passwords are shown as encrypted if the global password encryption is enabled. The maximum for the file is 5000 users, 100 groups, 25 clients, 5 realms and 2 LDAP servers.

User ID	Define a unique user ID that differentiates this user from others with similar attributes.
Guest User	Select the Guest User checkbox to assign this particular user temporary access to the local Radius server, thus restricting their authentication period to a user defined interval.
Password	Enter the password that adds the user to the list of approved users displayed within the Users tab.

Confirm Password	Re-enter (confirm) the password used to add the user to the list of approved users displayed within the Users tab.
Current Switch Time	Displays the read only switch time. This is the time used for expiry data and time.
Expiry Date & Time	Defines the date and time (in dd:MM:yyyy-hh:mm) format to timeout users with temporary permissions.
Available Groups	Use the Available Groups **Add ->** and **Remove <-** functions to map groups (for inclusion) for this specific user.
Configured Group	Refer to the **Configured Group**s field to assess the groups defined thus far.

a. Refer to the **Status** field for the current state of the requests made from applet. This field displays error messages if something goes wrong in the transaction between the applet and the switch.

b. Click **OK** to use the changes to the running configuration and close the dialog.

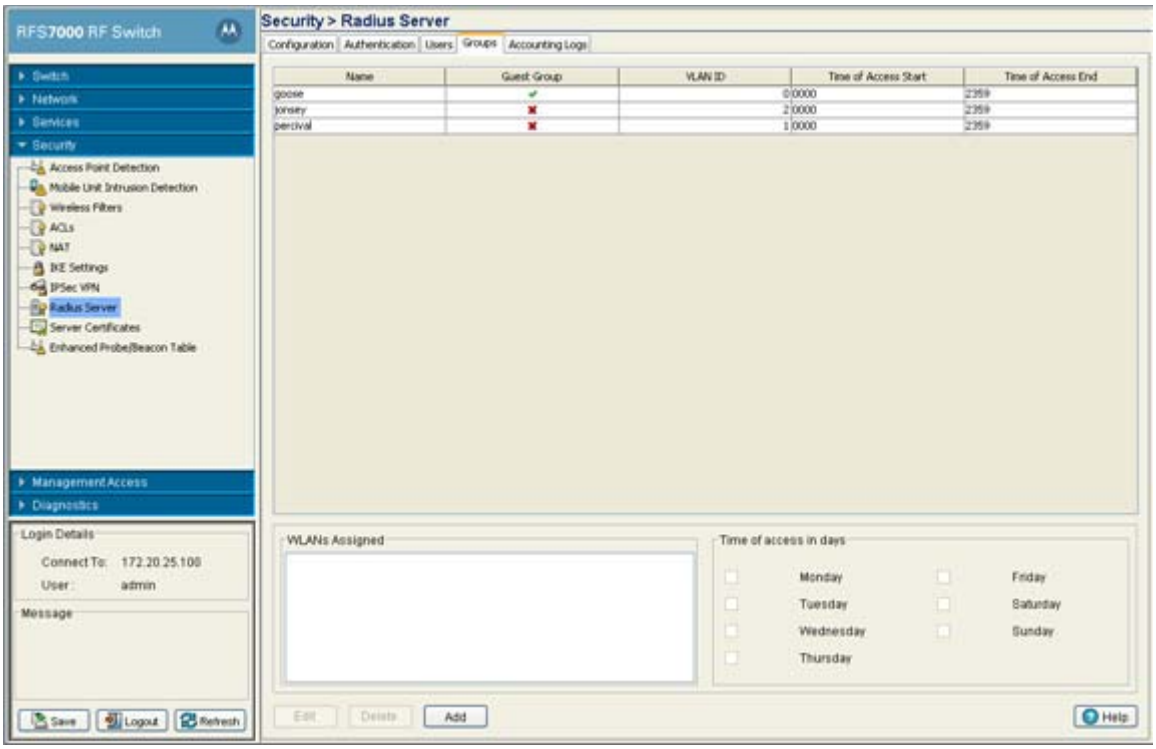
c. Click **Cancel** to close the dialog without committing updates to the running configuration

6.9.6 Configuring Radius User Groups

The **Groups** tab displays a list of all groups in the local Radius server's database. The groups are listed in the order added. The existing configuration for each group is displayed to provide the administrator the option of using a group as is, modifying an existing group's properties or creating a new group.

To access the configuration of existing user groups:

1. Select **Security** > **Radius Server** from the main menu.
2. Select the **Groups** tab.



3. Refer to the user groups listed to review the following read-only attributes for each group:

Name	Displays the unique name assigned to each group. The group name should be indicative of the user population within and their shared activity within the switch managed network.
Guest Group	Displays whether a specific group has been defined as a guest group (indicated with a green check mark) or has been configured as permanent group (indicated with a red X). Guest users have temporary Radius server access.
VLAN ID	Display the VLAN ID(s) used by each group listed. The VLAN ID is representative of the shared SSID each group member (user) employs to interoperate with one another within the switch managed network (once authenticated by the local Radius server).
Time of Access Start	Displays the time each group is authenticated to interoperate within the switch managed network. Each user within the group is authenticated with the local Radius server. Group members successfully authenticated are allowed access to the switch managed network under the restrictions defined for that group.

Time of Access End	Displays the time each group's user base will loose access privileges. After this time, users within this group will not be authenticated by the local Radius server. However, if a user is part of a different group that has not exceeded their access interval, then the user may still interoperate with the switch (remain authenticated) as part of that group.

4. Refer to the **WLANs Assigned** area of the Groups tab to review which switch WLANs are available for use with configured groups.
5. Refer to the **Time of access in days** field to assess the intervals (which days) the group has been assigned access to the switch managed network (after each user has been authenticated). At least one day is required.

   This value is read-only within the Groups tab. Click **Edit** to modify the access assignments of an existing group or click **Add** to create a new group with unique access assignments. Editing guest designations is not permitted.
6. To modify the attributes of an existing group, select the group from the list of groups displayed and click the **Edit** button.

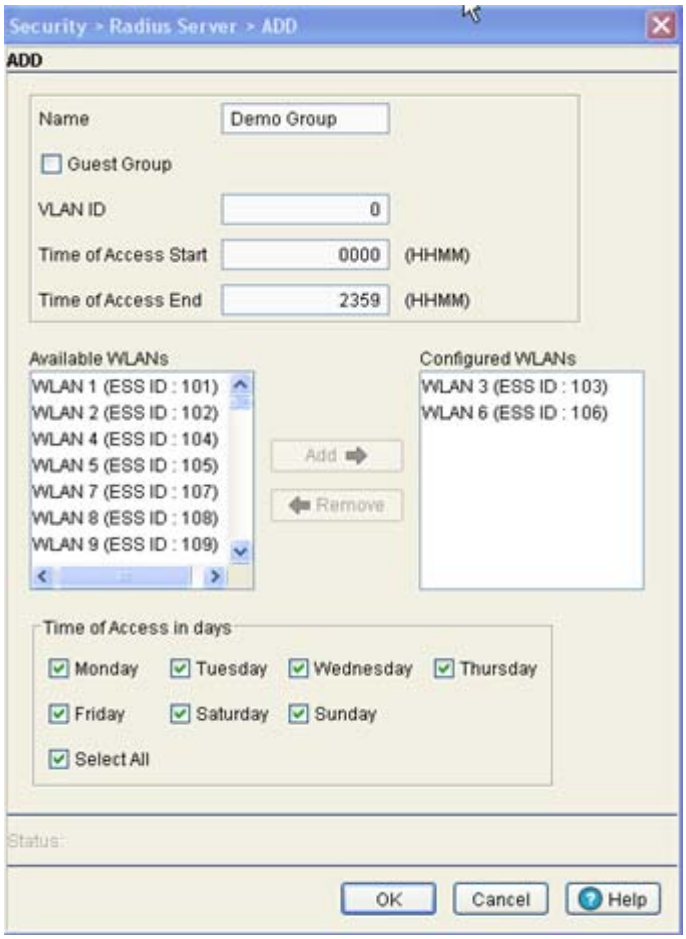
   Modify the existing group's guest designation, VLAN ID, access period and WLAN assignment.
7. If an existing group is no longer needed (perhaps obsolete in function), select the group and click the **Delete** button to permanently remove the group from the list. The group can only be removed if all the users in the group are removed first.
8. To create a new group, click the **Add** button and provide the following information.

Name	Define a unique group name that differentiates this new group from others with similar attributes.
Guest Group	Select the **Guest Group** checkbox to assign this particular group (and the users within) only temporary access to the local Radius server, thus restricting their authentication period to a user defined access interval.
VLAN ID	Define the VLAN ID for the new group. The VLAN ID is representative of the shared SSID each group member (user) employs to interoperate within the switch managed network (once authenticated by the local Radius server).
Time of Access Start	Set the time the group is authenticated to interoperate. Each user within the group is authenticated with the local Radius server. Those group members successfully authenticated are allowed access to the switch using the restrictions defined for the group.
Time of Access End	Set the time each group's user base will loose access privileges within the switch managed network. After this time, users within this group will not be authenticated by the local Radius server. However, if a user is part of a different group that has not exceeded their access end interval, the user may still interoperate with the switch (remain authenticated) as part of that group.

Available WLANs Use the Available WLANs **Add ->** and **Remove <-** functions to move WLANs for this new group from the available list to the configured list. Once on the configured list (and the changes applied), the members of this group can interoperate with the switch on these WLANs (once authenticated by the local Radius server).

Configured WLANs The Configured WLANs columns displays the WLANs this new group can operate within (once users are configured). Use the **Add ->** and **Remove <-** functions to move WLANs from the available list to the configured list.

Time of access in days Select the checkboxes corresponding to the days of the week you would like this new group to have access to the switch managed network. Of course, the user base within the group still needs to be authenticated by the local Radius server first.



a. Refer to the **Status** field for the current state of requests made from applet. This field displays error messages if something goes wrong in the transaction between the applet and the switch.

b. Click **OK** to use the changes to the running configuration and close the dialog.

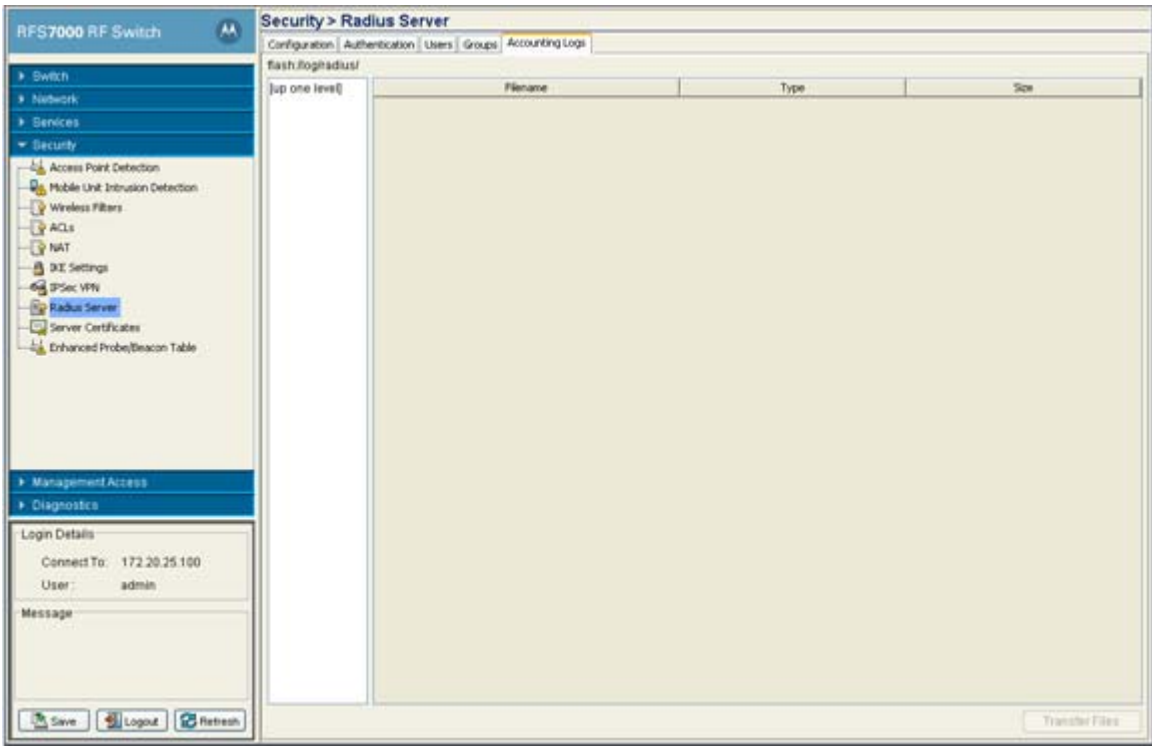
c. Click **Cancel** to close the dialog without committing updates to the running configuration.

6.9.7 Viewing Radius Accounting Logs

Accounting logs contain information about the use of remote access services by users. This information is of great assistance in partitioning local versus remote users and how to best accommodate each. Remote user information can be archived to a location outside of the switch for periodic network and user permission administration.

To display the Radius accounting logs:

1. Select **Security** > **Radius Server** from the main menu.
2. Select the **Accounting Logs** tab.



3. Refer to the following information as displayed within the **Accounting Logs** tab.

Filename	Displays the name of each accounting log file. Use this information to differentiate files with similar attributes.
Type	Displays the file type.
Size	Display the size of the file.

NOTE An explicit purge operation is not supported, the accounting logs are purged automatically once they reach their limit.

6.10 Creating Server Certificates

Use the **Server Certificates** screen to view existing self-signed certificate values. The values displayed are read-only. The Server Certificates screen also allows an administrator to:

- *create a certificate request*
- *send it to a Certificate Authority (CA)*
- *create a self signed certificate*
- *upload an external certificate*
- *delete a server certificate and/or root certificate of a trustpoint*
- *create a new key*
- *upload/download keys to and from the switch to and from a server or local disk*
- *delete all the keys in the switch.*

Server certificates are issued to Web Servers and used to authenticate Web Servers to browsers while establishing a *Secure Socket Layer* (SSL) connection.

The **Server Certificates** screen displays two tabs supporting the following:

- *Using Trustpoints to Configure Certificates*
- *Configuring Trustpoint Associated Keys*

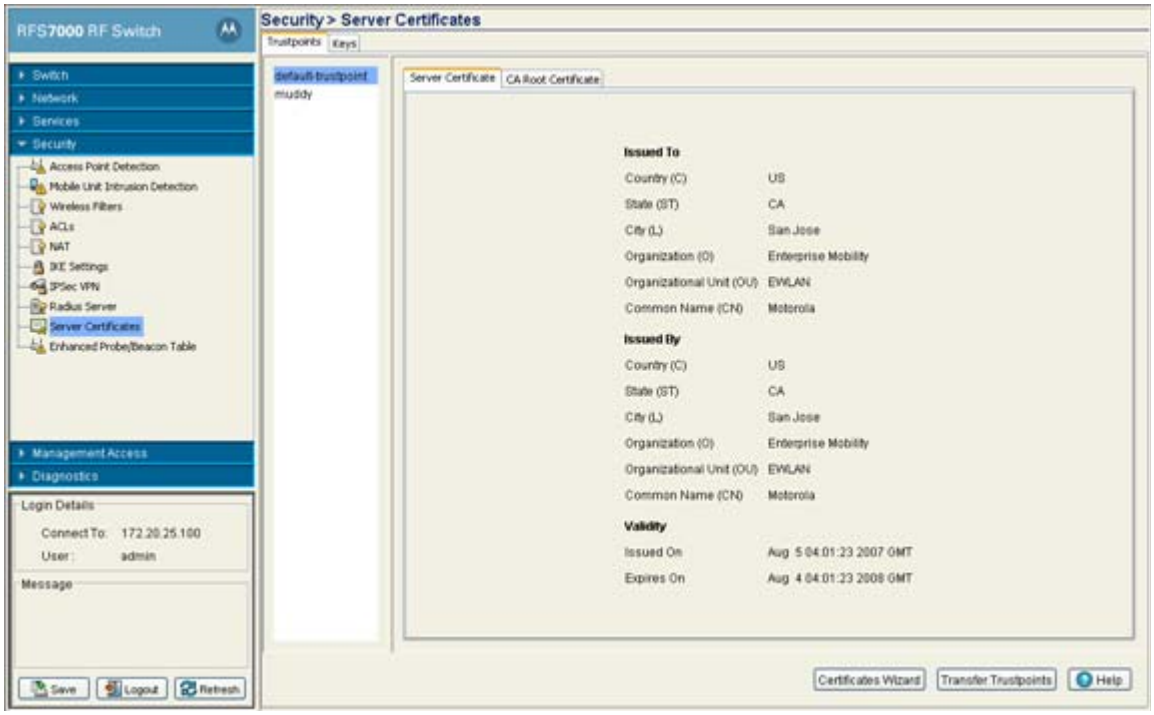
6.10.1 Using Trustpoints to Configure Certificates

Each certificate is digitally signed by a trustpoint. The trustpoint signing the certificate can be a certificate authority, corporation or individual. A trustpoint represents a CA/identity pair containing the identity of the CA, CA-specific configuration parameters, and an association with an enrolled identity certificate.

To view current certificates values:

1. Select **Security** > **Server Certificates** from the main menu tree.

2. Select the **Trustpoints** tab.



A panel (on the far left of the screen) displays currently enrolled trustpoints.

The **Server Certificate** and **CA Root Certificate** tabs display read-only credentials for the certificates in use by the switch. A table displays the following **Issued To** and **Issued By** details for each**:**

Issued To

Country (C)	Displays the country of usage for which the certificate was assigned.
State (ST)	Displays the state (if within the US) or province within the country listed above wherein the certificate was issued.
City (L)	Lists the city wherein the server certificate request was made. The city should obviously be within the State/Prov stated.
Organization (O)	Displays the name of the organization making the certificate request.
Org. Unit (OU)	Displays the name of the organizational unit making the certificate request.
Common Name (CN)	If there is a common name (IP address) for the organizational unit making the certificate request, it displays here.

Issued By

Country (C)	Displays the Country of the certificate issuer.
State (ST)	Displays the state or province for the country the certificate was issued.
City (L)	Displays the city representing the state/province and country from which the certificate was issued.

Organization (O)	Displays the organization representing the certificate authority
Organizational Unit	If a unit exists within the organization that is representative of the certificate issuer, that name should be displayed here.
Common Name	If there is a common name (IP address) for the organizational unit issuing the certificate, it displays here.
Validity	
Issued On	Displays the date the certificate was originally issued.
Expires On	Displays the expiration date for the certificate.

3. Click the **Certificate Wizard** button to create a self signed certificate, upload an external server certificate (and/or a root certificate) and delete a server certificate (and/or a root certificate) of a trustpoint. For more information, see *Using the Wizard to Create a New Certificate on page 6-89*.

6.10.1.1 Creating a Server / CA Root Certificate

To create a Server Certificate or CA Root Certificate:

1. Select **Security** > **Server Certificates** from the main menu tree.
2. Click the **Certificate Wizard** button on the bottom of the screen.
3. Use this wizard for:
   - *Creating a new self-signed certificate or certificate request*
   - *Uploading an external certificate*
   - *Delete operations*
4. Select the **Create new certificate** radio button to generate a new self-signed certificate or prepare a certificate request which can be sent to a *Certificate Authority* (CA).

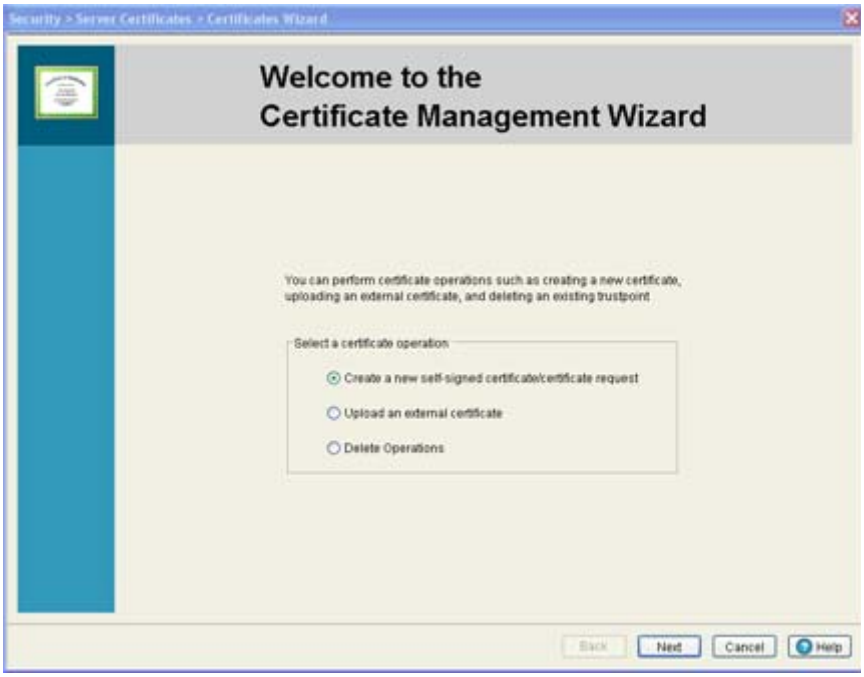
   For more information, see *Using the Wizard to Create a New Certificate on page 6-89*.
5. Select the **Upload an external certificate** radio button to upload an existing Server Certificate or CA Root Certificate.
6. Select the **Delete Operations** radio button to delete trustpoints and all related keys.

   For more information, see *Using the Wizard Delete Operation on page 6-93*.

Using the Wizard to Create a New Certificate

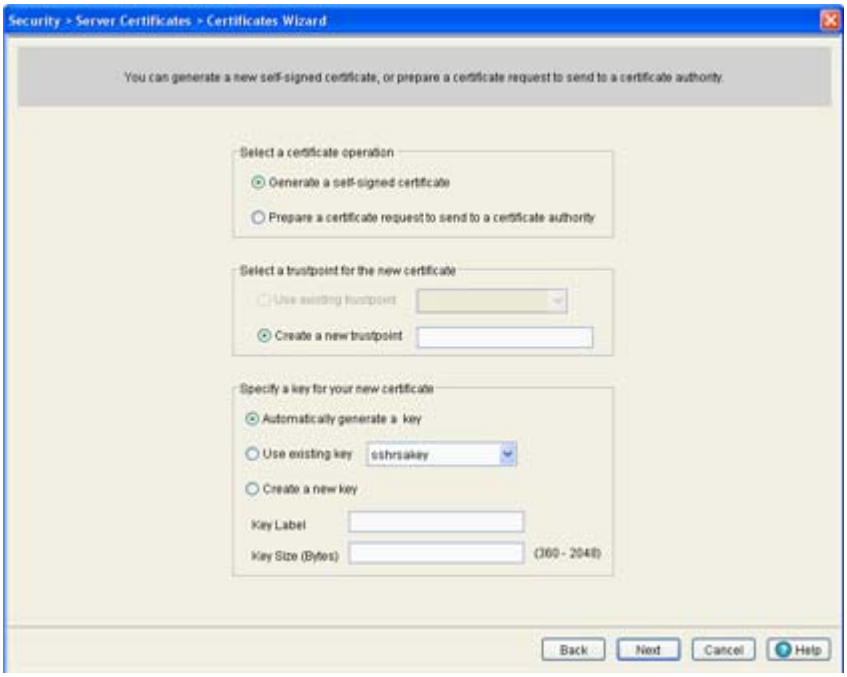
To generate a new self-signed certificate or prepare a certificate request:

1. Select the **Create new self-signed certificate /certificate request** radio button in the wizard and click the **Next** button.


Security > Server Certificates > Certificates Wizard
Welcome to the
Certificate Management Wizard
You can perform certificate operations such as creating a new certificate, uploading an external certificate, and deleting an existing trustpoint
Select a certificate operation
Create a new self-signed certificate/certificate request
Upload an external certificate
Delete Operations
Back
Next
Cancel
Help

   The second page of the wizard contains three editable fields, **Select Certificate Operation**, **Select a Trustpoint**,and **Specify a key for you new certificate**.

2. Use the second page to create either a self signed certificate or prepare for a certificate request. For certificate operation, select one of the following options:
   - *Generate a self signed certificate* — Configure the properties of a new self-signed certificate. Once the values of the certificate are defined, the user can create and install the certificate.
   - *Prepare a certificate request to send to a Certificate Authority* — Configure and save a valid certificate request. Once the values of the certificate are defined, the user can configure and enroll the trustpoint.


Security > Server Certificates > Certificates Wizard
You can generate a new self-signed certificate, or prepare a certificate request to send to a certificate authority.
Select a certificate operation
Generate a self-signed certificate
Prepare a certificate request to send to a certificate authority
Select a trustpoint for the new certificate
Create a new trustpoint
Specify a key for your new certificate
Automatically generate a key
Use existing key
sshrsakey
Create a new key
Key Label
Key Size (Bytes)
(360 - 2048)
Back
Next
Cancel
Help

Select a trustpoint for the new certificate.

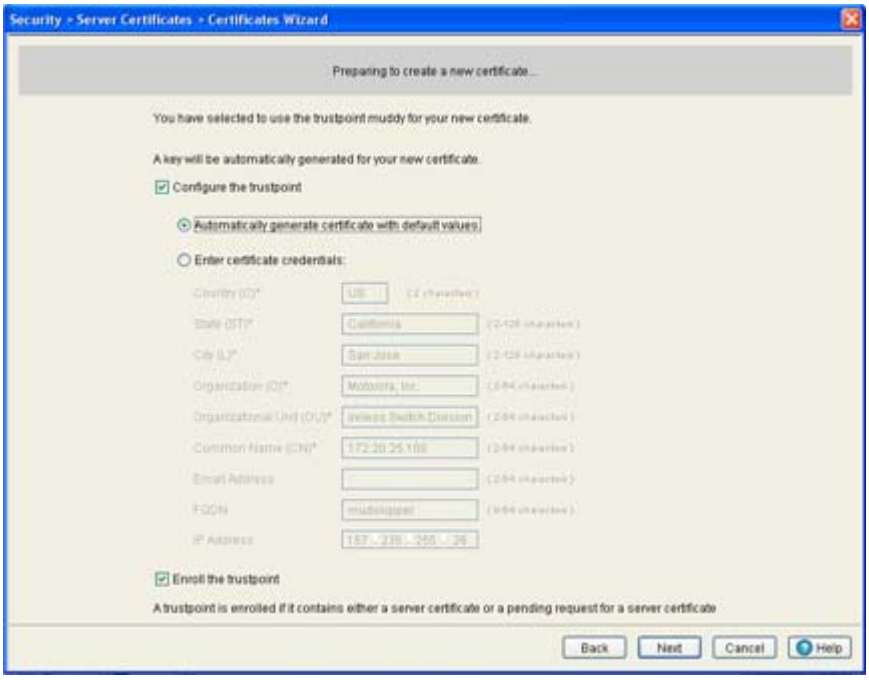
- *Use existing trustpoint* - Select an existing trustpoint from the drop-down menu.
- *Create a new trustpoint* - Provide a name for the new trustpoint in the space provided.

To specify the key for the new certificate, select one of the following options:

- *Automatically generate a key* — Select this option to automatically generate a key for the trustpoint.
- *Use existing key* — Select an existing key using the drop-down menu.
- *Use a new key* — Select this option to create a new key for the trustpoint. Define a key name and size as appropriate.

Associate the certificate selected with one of the options provided in the *Specify a key for your new certificate* and click the **Next** button.

If generating a new self-signed certificate (as selected in page 2 of the wizard), the wizard continues the installation. Use the third page of the wizard to enter a unique trustpoint name and other credentials required to create the new certificate.


Security > Server Certificates > Certificates Wizard
Preparing to create a new certificate...
You have selected to use the trustpoint muddy for your new certificate.
A key will be automatically generated for your new certificate.
Configure the trustpoint
Automatically generate certificate with default values
Enter certificate credentials:
Enroll the trustpoint
A trustpoint is enrolled if it contains either a server certificate or a pending request for a server certificate
Back
Next
Cancel
Help

3. Select the **Configure the trustpoint** checkbox to enable the new self signed certificate to be configured as a trustpoint.
4. Select the **Automatically generate certificate with default values** checkbox to create a certificate using values the switch assigns by default.

   This option is recommended for generic certificates that do not represent a unique or custom switch configuration.
5. Select the **Enter certificate credentials** radio button to manually enter the values of a unique certificate. If you anticipate using generic (default) values, consider using the Automatically generate certificate with default values option.
6. Provide the following information for the certificate:

Country	Define the Country used in the Self-Signed Certificate. By default, the Country is US. The field can be modified by the user to other values. This is a required field and must not exceed 2 characters.
State	Enter a State/Prov. for the state or province name used in the Self-Signed Certificate. By default, the State/Prov. field is CA. This is a required field.
City	Enter a City to represent the city name used in the Self-Signed Certificate. By default, the City name is San Jose. This is a required field.
Organization	Define an Organization for the organization used in the Self-Signed Certificate. By default, it is Motorola, Inc. The user is allowed to modify the Organization name. This is a required field.

Organization Unit	Enter an Org. Unit for the name of the organization unit used in the Self-Signed Certificate. By default, it is Wireless Switch Division. This is a required field.
Common Name	Define a Common Name for the URL of the switch. This is a required value. The Common Name must match the URL used in the browser when invoking the switch applet.
Email Address	Provide an email address used as the contact address for issues relating to this certificate request.
FQDN	Enter a *fully qualified domain name* (FQDN) is an unambiguous domain name that specifies the node's position in the DNS tree hierarchy absolutely. To distinguish an FQDN from a regular domain name, a trailing period is added. ex: somehost.example.com. An FQDN differs from a regular domain name by its absoluteness; as a suffix is not added.
IP Address	Specify the switch IP address used as the switch destination for certificate requests.

7. Select the **Enroll the trustpoint** checkbox to enroll the certificate request with the CA.
8. Click **Next** to proceed with the certificate creation.

   The fourth page of the wizard concludes the creation of the self certificate. The fourth page displays the details of the certificate.
   If you selected to prepare a certificate request in the page 2, the wizard continues, prompting the user for the required information to complete the certificate request. Click **Next** to continue.

   The fifth page of the wizard prompts the user to enter the trustpoint name and other credentials required to create a new certificate.
9. Use the **Enter trustpoint name** parameter to assign a name to the trustpoint.
10. Provide Certificate Credential information for the following:

Country	Define the Country used in the Self-Signed Certificate. By default, this Country is US. The field can be modified by the user to other values. This is a required field and must not exceed 2 characters.
State	Enter a State/Prov. for the state or province name used in the Self-Signed Certificate. By default, the State/Prov. field is Province. This is a required field.
City	Enter a City to represent the city name used in the Self-Signed Certificate. By default, the City name is City. This is a required field.
Organization	Define an Organization for the organization used in the Self-Signed Certificate. By default, it is Company Name. The user is allowed to modify the Organization name. This is a required field.
Organization Unit	Enter an Org. Unit for the name of the organization unit used in the Self-Signed Certificate. By default, it is Department Name. This is a required field.
Common Name	Define a Common Name for the switch URL. This is a required value. The Common Name must match the URL used in your browser when invoking the switch applet.
Password	Provide the password required to access the URL.

FQDN	Enter a *fully qualified domain name* (FQDN) as an unambiguous domain name that specifies the node's position in the DNS tree hierarchy absolutely. To distinguish an FQDN from a regular domain name, a trailing period is added (somehost.example.com). An FQDN differs from a regular domain name by its absoluteness; as a suffix is not added
IP Address	Specify the switch IP address used as the switch destination for certificate requests.

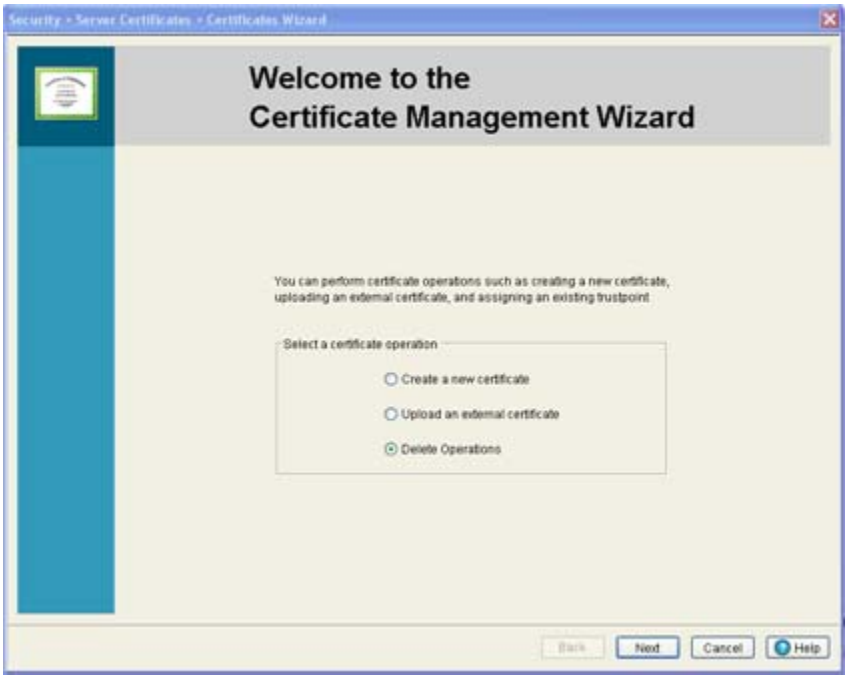
11. Click the **Next** button to continue preparing the certificate request.

Using the Wizard Delete Operation

The wizard can also be used to delete entire trustpoints, the certificate used with a trustpoint or the CA root certificate use with a trustpoint. Delete trustpoint properties as the become obsolete or the properties of a certificate are no longer relevant to the operation of the switch.

To use the wizard to delete trustpoint properties:

1. Select the **Delete Operations** radio button and click the **Next** button.


Security > Server Certificates > Certificates Wizard
Welcome to the
Certificate Management Wizard
You can perform certificate operations such as creating a new certificate, uploading an external certificate, and assigning an existing trustpoint
Select a certificate operation
Create a new certificate
Upload an external certificate
Delete Operations
Back
Next
Cancel
Help

   The next page of the wizard is used to delete the trustpoint.

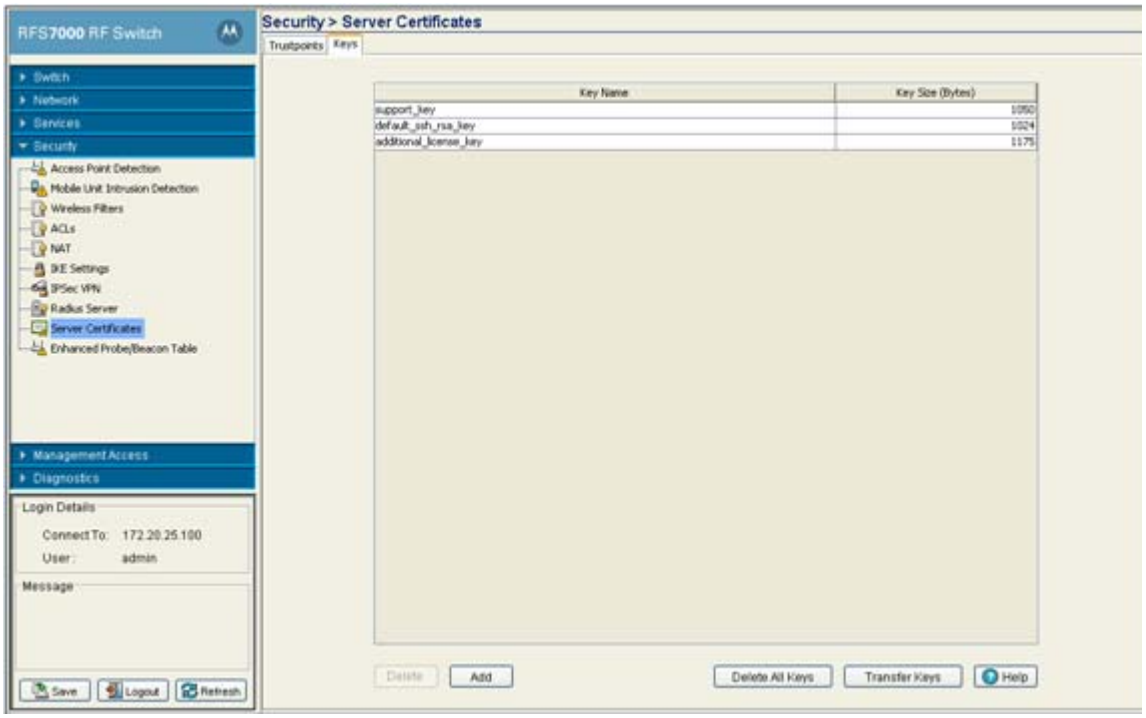
2. Select and use the **Delete trustpoint and all certificates inside it** drop-down menu to define the target trustpoint for removal.
3. Select and use the **Remove certificates from this trustpoint** drop-down menu define the trustpoint that will have either its **Server Cervices** or **CA Root Certificate** removed
4. Click the **Next** button to proceed and complete the trustpoint removal.

6.10.2 Configuring Trustpoint Associated Keys

Trustpoint keys allow a user to use different *Rivest, Shamir, an Adelman* (RSA) key pairs. Therefore, the switch can maintain a different key pair for each certificate to significantly enhance security.

To configure the keys associated with trustpoints:

1. Select **Security** > **Server Certificates** from the main menu tree.
2. Select the **Keys** tab.



The Keys tab displays the following:

Key Name	Displays the name of the key pair generated separately, or automatically when selecting a certificate. Specify the option within the wizard.
Key Sizes	Displays the size of the desired key. If not specified, a default key size of 1024 is used.

3. Highlight a Key from the table and click the **Delete** button to delete it from the switch.
4. Click on **Add** button to add a new key label to the list of keys available to the switch. For more information, see *Adding a New Key on page 6-95*.
5. Select the **Delete All Keys** options to delete all of the keys displayed.
6. Click on **Transfer Keys** to archive the keys to a user-specified location. For more information, see *Transferring Keys on page 6-95*.

6.10.2.1 Adding a New Key

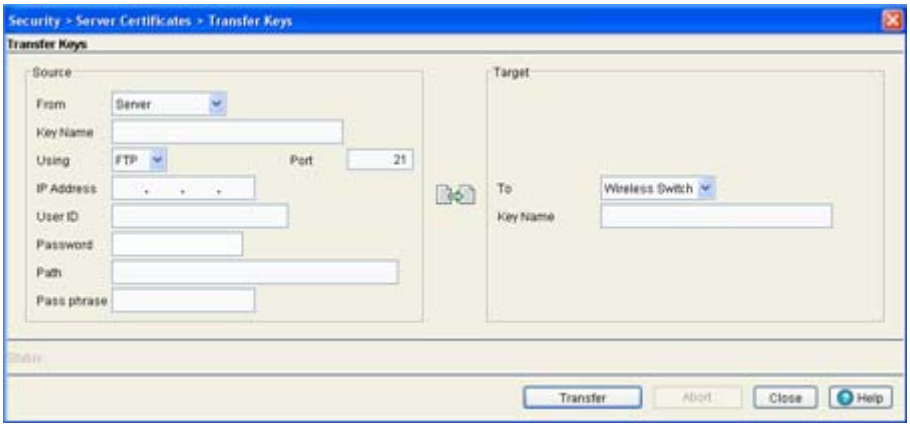
If none of the keys listed within the Keys tab are suitable for use with a certificate, consider creating a new key pair.

1. Select **Security** > **Server Certificates** from the main menu tree.
2. Select the **Keys** tab.
3. Click the **Add** button at the bottom of the screen.

4. Enter a **Key Name** in the space provided to specify a name for the new key pair.
5. Define the **Key Size** between 1024 and 2048 in the space provided.
6. Refer to the **Status** field for the current state of the requests made from applet. This field displays error messages if something goes wrong in the transaction between the applet and the switch.
7. Click **OK** to save the changes to the running configuration and close the dialog.
8. Click **Cancel** to close the dialog without committing updates to the running configuration.

6.10.2.2 Transferring Keys

The **Transfer** screen allows for the transfer of keys to and from the switch to (and from) a server or local disk. Transferring keys is recommended to ensure server certificate key information is available if problems are encountered with the switch and the data needs to be retreived.



1. Select **Security** > **Server Certificate** from the main menu tree.
2. Click the **Keys** Tab.
3. Highlight a target file, and select the **Transfer** Keys button.
4. Use the **From** drop-down menu to specify the location from which the log file is sent. If only the applet is available as a transfer location, use the default switch option.
5. Select a target file for the file transfer from the **File** drop-down menu.

The drop-down menu contains the log files listed within the Server Certificate screen.

6. Use the **To** drop-down menu to define whether the target log file is to be sent to the system's local disk (Local Disk) or to an external server (Server).
7. Provide the name of the file to be transferred to the location specified within the **Target** field.
8. Use the **Using** drop down-menu to configure whether the log file transfer will be sent using FTP or TFTP.
9. Enter the **IP Address** of destination server or system receiving the target log file.
10. Enter the **User ID** credentials required to send the file to the target location.

    Use the user ID for FTP transfers only.
11. Enter the **Password** required to send the file to the target location using FTP.
12. Specify the appropriate **Path** name to the target directory on the local system disk or server as configured using the "To" parameter.

    If the local server option is selected, use the browse button to specify the location on the local server.
13. Refer to the **Status** field for the current state of the requests made from applet. This field displays error messages if something goes wrong in the transaction between the applet and the switch.
14. Click the **Transfer** button when ready to move the target file to the specified location.

    Repeat the process as necessary to move each desired log file to the specified location.
15. Click the **Abort** button to terminate the file transfer should you encounter a problem.
16. Click the **Close** button to exit the screen after a transfer. There are no changes to save or apply.

6.11 Configuring Enhanced Beacons and Probes

The switch can be configured to detect and locate rogue APs and MUs. Refer to *Editing AP Settings on page 4-88* to enable an AP to forward beacons and association information for AP radios to detect a rogue. An AP can also be configured to forward MU probe requests to the switch to help locate a rogue MU.

NOTE Currently, only an AP300 model access port supports enhanced beacons and probes request forward configuration.

Use the Enhanced Beacons/Probe screen to configure enhanced beacons/probes and their reports. It consists of the following tabs:

- *Configuring the Beacon Table*
- *Configuring the Probe Table*
- *Reviewing the Beacons Found Report*
- *Reviewing the Probes Report*

6.11.1 Configuring the Beacon Table

The Beacon Table is used to detect rogue APs. An AP300 transmits beacons and MUs send a probe request to the AP for association. The AP300 (on receipt of the probe request) sends a probe response and forms an AP-MU association.

When enabling an Enhanced Beacon, the switch allows adopted access ports to periodically scan for rogue APs on different channels without disassociating MUs. The beacons collected in the scan are passed on to the switch so required information is gathered to locate a particular rogue AP. Refer to *Editing AP Settings on page 4-88* to enable an AP to forward beacons and association information for AP radios to detect rogue APs.

The switch uses a set of 802.11a and 802.11bg radio specific channels. The switch radio scans each channel to detect the potential existence or rogues operating on the configured channel. On completion of a scan, the switch moves the AP back to its original operating channel.

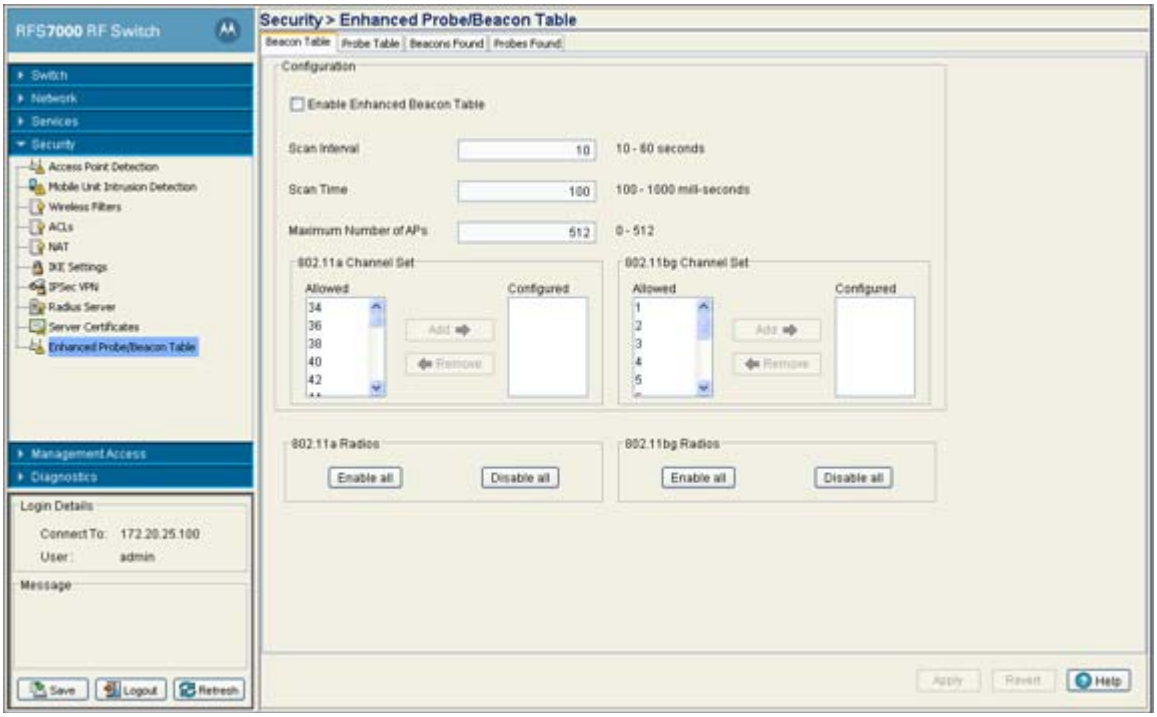
If, during the scan, an AP is detected on a different channel (due to a leaked signal), this channel is also added to the channel set. The AP sends this information to the switch, which maintains a table with the following information:

- *MAC address of the detected rogue AP*
- *AP MAC address*
- *Signal strength of the detected rogue AP*
- *Channel on which the AP was detected*
- *Time when the AP was detected.*

This information is used by the Motorola RF Management application (or Motorola RFMS) to locate the rogue AP. Motorola RFMS uses this information to physically locate the position of rogues and authorized devices within a site map representative of the physical dimensions of the actual device deployment area.

To configure enhanced beacons:

1. Select **Security** > **Enhanced Probe/Beacon Table** from the main menu tree.
2. Select the **Beacon Table** tab.



3. Select the **Enable Enhanced Beacon Table** checkbox to allow the AP to receive beacons and association information.

4. Use **Scan Interval** value to enter the interval used by the radio between scans. The radio scans each channel for the defined interval. The default value is 10 seconds.
5. Use the **Scan Time** value to enter the duration of the scan. The radio scans each channel for the defined interval. The default value is 100 milliseconds.
6. Use the **Max Number of APs** value to configure the number of detected APs displayed in the Beacon Found table. The available range is from 0 to 512.
7. Refer to **802.11a Channel Set** field to select channels for the 802.11a transmission band. The channel information is provided to the switch, which then makes an 802.11a radio scan for the configured channels.

Allowed	Displays all the channels available to the AP. The channel list is country specific and differs from country to country.
Add ->	Select a channel frequency and click the **Add ->** button to include the channel to the **Configured** list box. You can select multiple channels and add them to the **Configured** list box. Press the Ctrl button and use the mouse to select multiple channels. The switch uses an 802.11a radio to scan the selected channels to detect any rogue AP's.
<- Remove	Select the channel's frequency from the Configured list box and click **<- Remove** to remove a channel from the list of channels provided to the switch.
Configured	Displays the channels provided to the switch. The switch makes all the 802.11a radios move to a channel from this channel-set and scan these channels, one at a time, for a configurable duration.
Enable all	Select the **Enable all** button (within the 802.11a Radios field) to enable all 802.11a radios from receive beacons.
Disable all	Select the **Disable all** button (within the 802.11a Radios field) to disable all 802.11a radios from receiving beacons.

8. Refer to **802.11bg Channel Set** field to select channels for the 802.11bg transmission band. The channel information is provided to the switch, which conducts an 802.11bg scan for each channel.

Allowed	Displays all the channels available to the AP. The channel list is country specific and differs from country to country.
Add ->	Select a channel frequency and click the **Add ->** button to include the channel to the **Configured** list box. Select multiple channels and add them to the **Configured** list box. Press the Ctrl button and use the mouse to select multiple channels. The switch uses an 802.11a radio to scan the selected channels to detect any non-adopted or rogue AP's.
<- Remove	Select the channel's frequency from the Configured list box and click **<- Remove** to remove a channel from the list of channels provided to the switch.
Configured	Displays the channels provided to the switch. The switch makes all the 802.11bg radios move to a channel from this channel-set and scan these channels, one at a time, for a configurable duration.

Enable all	Select the **Enable** button (within the 802.11bg Radios field) to enable all the 802.11bg radios receive enhanced beacons.
Disable all	Select the **Disable** button (within the 802.11bg Radios field) to disable all the 802.11bg radios from receiving enhanced beacons.

9. Click **Apply** to save changes to the screen. Navigating away from the screen without clicking the Apply button results in changes being discarded.
10. Click the **Revert** button to undo the changes to the screen and revert to the last saved configuration.

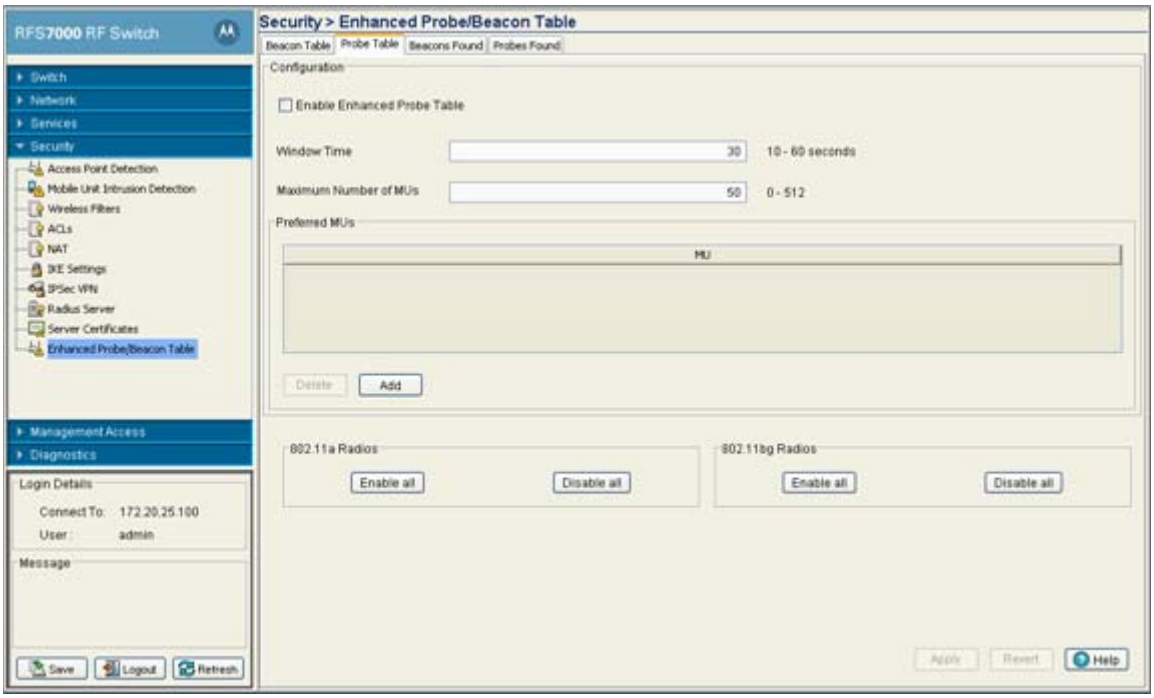
6.11.2 Configuring the Probe Table

Define enhanced probes to detect rogue MUs within the network. An AP300 transmits beacons and the MUs sends a probe request to the AP for association. An AP300 (on receipt of the probe request) sends a probe response and associates to the MU.

When using an enhanced probe, an AP300 sends a probe response to the MU to associate. At the same time, the AP forwards the MU's probe request information to the switch. The switch maintains a table of the probe requests the AP300 receives from MUs. In conjunction with the Motorola RF Management application, the AP locates the rogue MU and displays its location within a Motorola RFMS maintained site map.

To configure enhanced beacons:

1. Select **Security** > **Enhanced Probe/Beacon Table** from the main menu tree.
2. Select the **Probe Table** tab.



3. Select the **Enable Enhanced Probe Table** checkbox to allow an AP to forward MU probe requests to the switch.

4. Define a **Window Time** (from 10 to 60 seconds) to set an interval used by the AP to record MU probe requests. The MU radio probe entry with the highest signal strength during the window period is recorded in the table.
5. Set a **Maximum Numbers of MU's** (from 0 to 512) to define the number of MUs configured in the switch table. The default value is 50 MUs.
6. The **Preferred MUs** table lists the MAC Addresses for all preferred MUs.
7. Select a MU from the Preferred MUs table and click the **Delete** button to remove the MU from the table.
8. Click the **Add** button to open a dialogue and add the MAC Address of a preferred MU to the table.
9. **802.11a Radios:** Click the **Enable All** button to allow an AP's 802.11a radio to receive MU probe requests and forward them to the switch.
10. **802.11a Radios:** Click the **Disable** button to stop AP's 802.11a radios from forwarding MU probe requests to the switch.
11. **802.11bg Radios:** Click the **Enable** button to allow the AP's 802.11bg radios to receive MU probe requests and forward them to the switch.
12. **802.11bg Radios:** Click the **Disable** button to stop AP's 802.11bg radios from forwarding MU probe requests to the switch.
13. Click **Apply** to save any changes. Navigating away from the screen without clicking the Apply button results in all the changes on the screen being discarded.
14. Click the **Revert** button to undo the changes to the screen and revert to the last saved configuration.

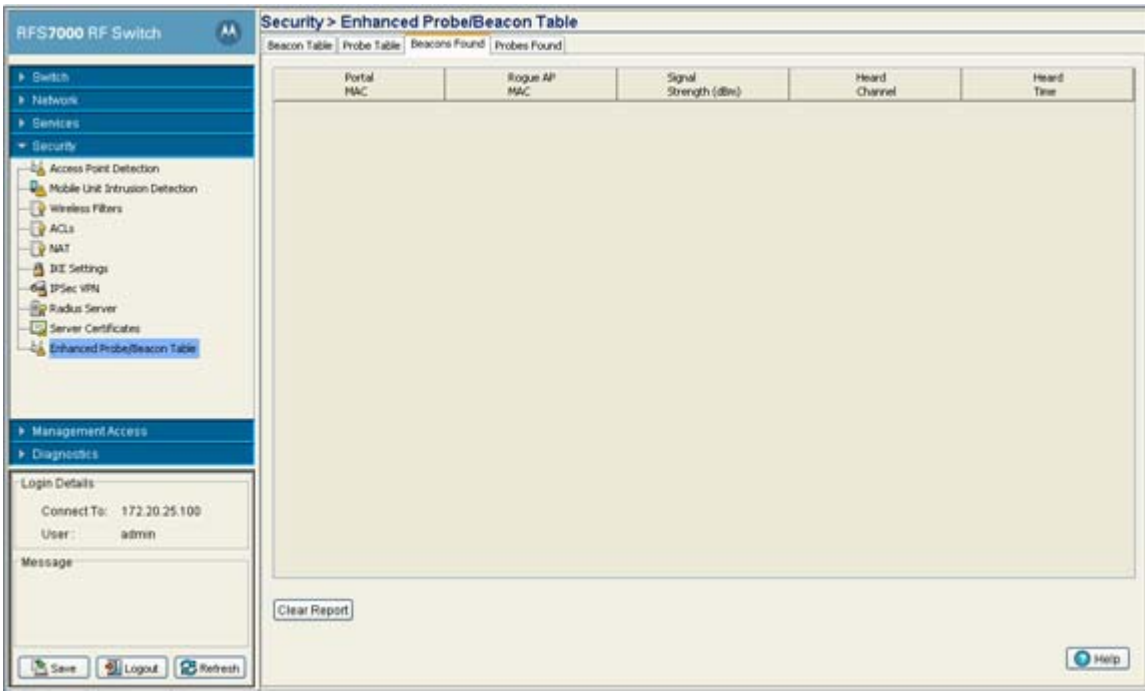
6.11.3 Reviewing the Beacons Found Report

Select the **Beacons Found** tab to view the enhanced beacons report created by the switch. The table displays beacon information collected during the AP's channel scan. The table contains at least 5 entries for each AP radio (channel) scan. The information displayed within the Beacons Found tab is read-only with no user configurable parameters.

To view the enhanced beacons report:

1. Select **Security** > **Enhanced Probe/Beacon Table** from the main menu tree.

2. Select the **Beacons Found** tab.



3. Refer to the following information as displayed within the **Beacons Found** tab.

Portal MAC	The MAC address of the unadopted AP detected by the enhanced beacon supported AP.
Rogue AP MAC	The MAC address of the enhanced beacon supported AP.
Signal Strength (dBm)	The signal strength when the unadopted AP was detected.
Heard Channel	The channel frequency when the unadopted AP was detected.
Hear Time	The time when the unadopted AP was detected.

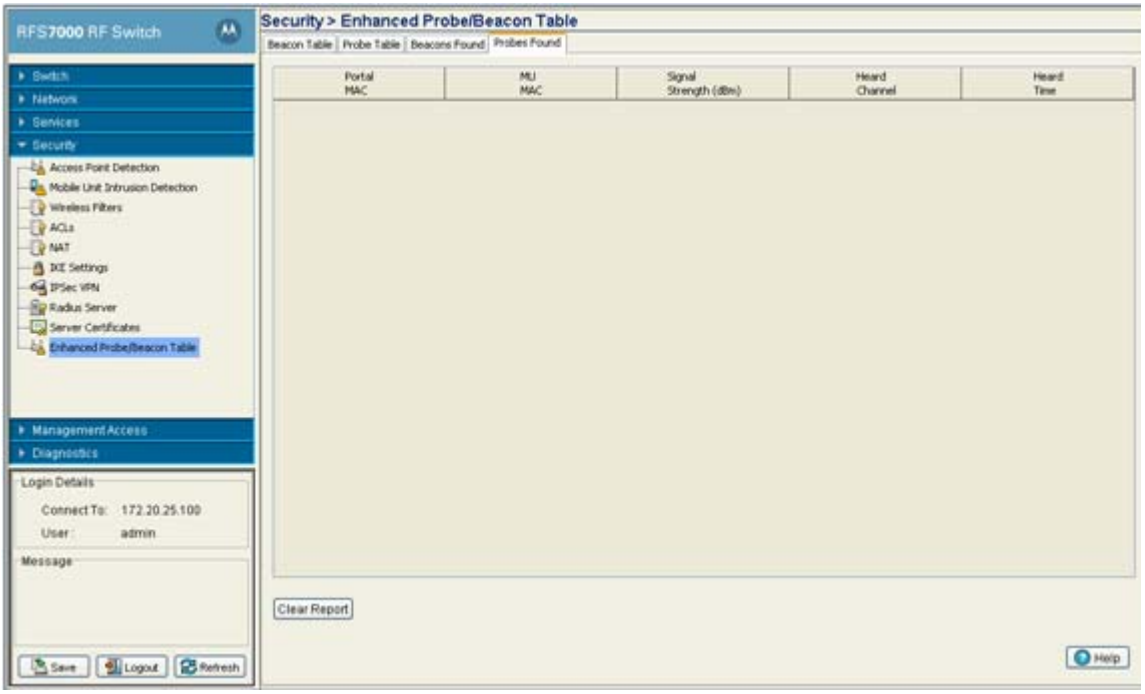
4. Click the **Clear Report** button to reset the statistic counters to zero and begin new calculations.

6.11.4 Reviewing the Probes Report

Refer to the **Probes Found** tab to view the enhanced Probe report created by the switch. The table displays probe information collected during the AP's channel scan. The information displayed within the Probes Found tab is read-only with no user configurable parameters.

To view the enhanced beacons table report:

1. Select **Security** > **Enhanced Probe/Beacon Table** from the main menu tree.
2. Select the **Probes Found** tab.



3. Refer to the following information as displayed within the **Probes Found** tab.

Portal MAC	The MAC address of the unadopted MU picked up by the Enhanced Probes enabled AP.
MU MAC	The MAC address of the Enhanced Probe detected MU.
Signal Strength (dBm)	The signal strength when the unadopted MU was detected.
Heard Channel	The channel frequency used when the unadopted MU was detected.
Heard Time	The time when the unadopted MU was detected.

4. Click the **Clear Report** button to reset the statistic counters to zero and begin new calculations.

7

Switch Management

This chapter describes the Management Access main menu items used to configure the switch. This chapter consists of the following switch management activities:

- *Displaying the Management Access Interface*
- *Configuring Access Control*
- *Configuring SNMP Access*
- *Configuring SNMP Traps*
- *Configuring SNMP Trap Receivers*
- *Configuring Management Users*

NOTE HTTPS must be enabled to access the switch applet. Ensure HTTPS access has been enabled before using the login screen to access the switch applet.

7.1 Displaying the Management Access Interface

Refer to the main Management Access interface for a high-level overview of the current switch firmware version and the current switch log output configuration. Use this information to discern whether a switch firmware upgrade is required (by checking the Website for a newer version) and if the switch is outputting log data appropriately.

NOTE When the switch's configuration is successfully updated (using the Web UI), the effected screen is closed without informing the user their change was successful. However, if an error were to occur, the error displays within the effected screen's Status field and the screen remains displayed. In the case of file transfer operations, the transfer screen remains open during the transfer operation and remains open upon completion (with status displayed within the Status field).

To display the main Management screen:

1. Select **Management Access** from the main menu tree.

2. Refer to the **Current Status** field to review the following read-only information:

Firmware In Use	The **Firmware In Use** value displays the software version currently running on the switch. Use this information to assess whether a firmware update would improve the switch feature set and functionality.
Log Output	The **Log Output** value displays the target location for log files output by the switch.

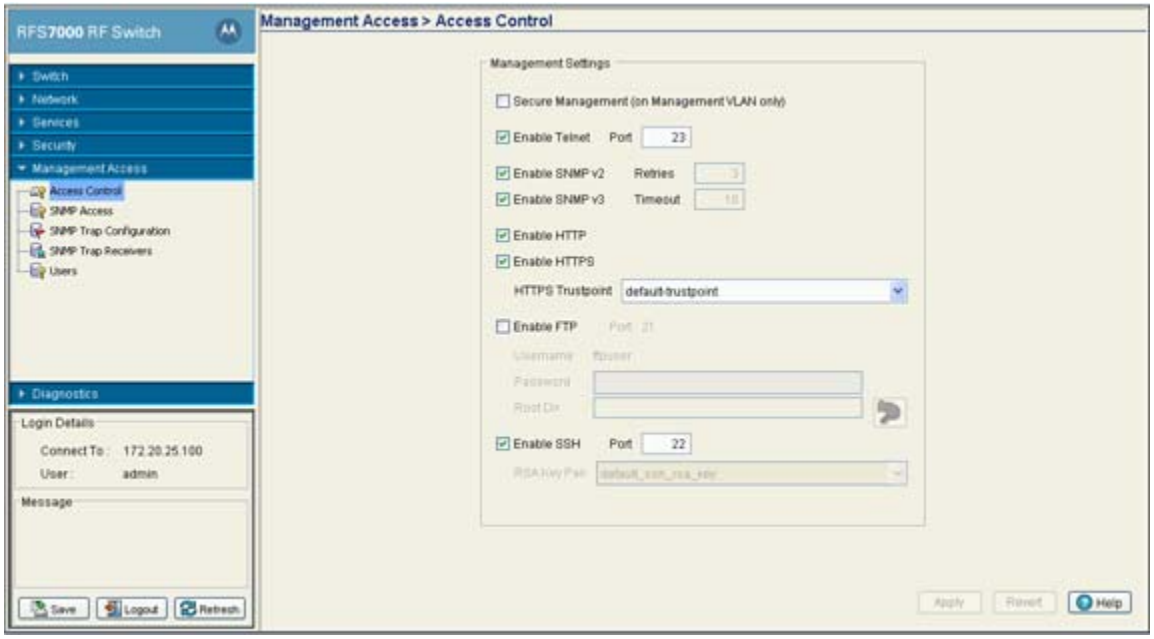
NOTE The **Apply** and **Revert** functions are greyed out within the Management Access screen, as this screen is has no configurable parameters for the user to update and save.

7.2 Configuring Access Control

Refer to the **Access Control** screen to allow/deny management access to the switch using the different protocols (HTTP, HTTPS, Telnet, SSH or SNMP) available to users. Access options are either enabled or disabled as required. The Access Control screen is not meant to function as an ACL (in routers or other firewalls), where you can specify and customize specific IPs to access specific interfaces.

To configure access control settings:

1. Select **Management Access** > **Access Control** from the main menu tree.



2. Refer to the **Management Settings** field to enable or disable the following switch interfaces:

Secure Management (on Management VLAN only)	Select this checkbox to allow management VLAN access to switch resources. The management VLAN is used to establish an IP connection to the switch from a workstation connected to a port in the VLAN. By default, the active management VLAN is VLAN 1, but you can designate any VLAN as the management VLAN. Only one management VLAN can be active at a time. This option is disabled (not selected) by default.
Enable Telnet	Select this checkbox to allow the switch to use a Telnet session for communicating over the network. This setting is enabled by default.
Port	Define the port number used for the Telnet session with the switch. This field is enabled as long as the Enable Telnet option remains enabled. The default port is port 23.
Enable SNMP v2	Select this checkbox to enable SNMPv2 access to the switch over the SNMPv2 interface. This setting is enabled by default.
Enable SNMP v3	Select this checkbox to enable SNMPv3 access to the switch over the SNMPv3 interface. This setting is enabled by default.

Retries	Define the number of retries the switch uses to connect to the SNMP interface if the first attempt fails. The default value is 3 retry attempts.
Timeout	When the provided interval is exceeded, the user is logged out of the SNMP session and forced re-initiate their connection. The default value is 10 minutes.
Enable HTTP	Select this checkbox to enable HTTP access to the switch. The *Hypertext Transfer Protocol* (HTTP) is an application-level protocol for distributed, collaborative, hypermedia information systems. This setting is enabled by default.
Enable HTTPS	Select this checkbox to enable HTTPS access to the switch. This setting is enabled by default.
HTTPS Trustpoint	Use the Trustpoint drop-down menu to select the local or default trustpoint used with a HTTPS session with the switch. For information on creating a new certificate, see *Creating Server Certificates on page 6-86*.
Enable FTP	Select this checkbox to enable FTP access to the switch. *File Transfer Protocol* (FTP) is the language used for file transfers across the Web. This setting is disabled by default.
Port	Displays the port number used for the FTP session with the switch (if using FTP).
Username	Displays the read-only name of the user whose credentials are used for the FTP session.
Password	If FTP is enabled, a password is required (for the user specified in the **Username** field) to use the switch with the FTP interface.
Root Dir.	Define the root directory where the FTP server is located (if using FTP). Click the Magnifying Glass icon to display a **Select Directory File** screen useful in selecting the root directory. If necessary a new directory folder can be created.
Enable SSH	Select this checkbox to enable SSH access to the switch. *Secure Shell* (SSH) is a program designed to perform a number of functions, such as file transfer between computers, command execution or logging on to a computer over a network. It is intended to do these tasks with greater security than programs such as Telnet or FTP. This setting is enabled by default.
Port	Define the port number used for the SSH session with the switch.
RSA Key Pair	Use the **RSA Key Pair** drop-down menu to select a public/private key pair used for RSA authentication. The default setting is "default_ssh_rsa_key"

NOTE You cannot establish a SSH session with the switch when a RSA Key with a length of 360 is associated with the SSH-Server.

3. Click the **Apply** button to save changes made to the screen since the last saved configuration.

4. Click the **Revert** button to revert the screen back to its last saved configuration. Changes made since the contents of the screen were last applied are discarded.

7.3 Configuring SNMP Access

Use the SNMP Access menu to view and configure existing SNMP v1/v2 and SNMP v3 values and their current access control settings. You can also view the SNMP V2/V3 events and their current values. The SNMP Access window consists of the following tabs:

- *Configuring SNMP v1/v2 Access*
- *Configuring SNMP v3 Access*
- *Accessing SNMP v2/v3 Statistics*

CAUTION Your system must be running Sun JRE version 1.5.x (or higher) or Mozilla for the switch Web UI to be used with the SNMP interface.

NOTE The SNMP facility cannot retrieve a configuration file directly from its SNMP interface. First deposit the configuration file to a computer, then FTP the file to the switch.

7.3.1 Configuring SNMP v1/v2 Access

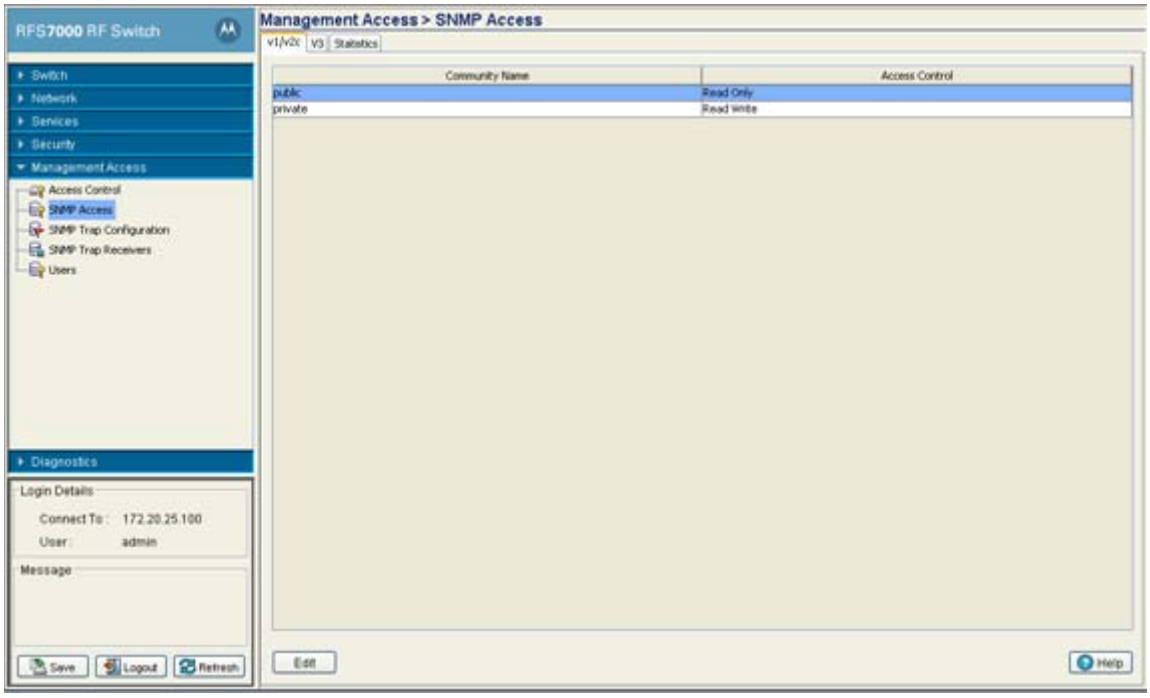
SNMP version 2 (SNMPv2) is an evolution of SNMPv1. The Get, GetNext, and Set operations used in SNMPv1 are exactly the same as those used in SNMPv2. However, SNMPv2 adds and enhances some protocol operations. The SNMPv2 Trap operation, for example, serves the same function used in SNMPv1, but uses a different message format and is designed to replace a SNMPv1 Trap.

Refer to the v1/v2c screen for information on existing SNMP v1/v2 community names and their current access control settings. Community names can be modified by selecting a community name and clicking the **Edit** button.

NOTE The SNMP undo feature is not supported.

To review existing SNMP v1/v2 definitions:

1. Select **Management Access** > **SNMP Access** > **v1/v2** from the main menu tree.



2. Refer to the **Community Name** and **Access Control** parameters for the following information:

Community Name	Displays the read-only or read-write name used to associate a site-appropriate name for the community. The name is required to match the name used within the remote network management software. Click the **Edit** button to modify an existing Community Name.
Access Control	The Access Control field specifies a read-only (R) access or read/write (RW) access for the community. Read-only access allows a remote device to retrieve information, while read/write access allows a remote device to modify settings. Click the **Edit** button to modify an existing Access Control permission.

3. Highlight an existing entry and click the **Edit** button to modify the properties of an existing SNMP V1/v2 community and access control definition. For more information, see *Editing an Existing SNMP v1/v2 Community Name on page 7-6*.

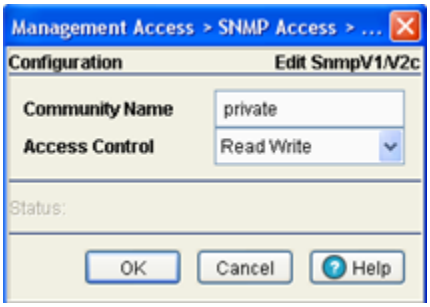
7.3.1.1 Editing an Existing SNMP v1/v2 Community Name

The **Edit** screen allows the user to modify a community name and change its read-only or read/write designation. Since the community name is required to match the name used within the remote network management software, it is recommended the name be changed appropriately to match a new naming (and user) requirement used by the management software.

To modify an existing SNMP v1/v2 Community Name and Access Control setting:

1. Select **Management Access** > **SNMP Access** > **v1/v2** from the main menu tree.

2. Select an existing Community Name from those listed and click the **Edit** button.



3. Modify the **Community Name** used to associate a site-appropriate name for the community. The name revised from the original entry is required to match the name used within the remote network management software.
4. Modify the existing read-only (R) **access** or read/write (RW) **access** for the community. Read-only access allows a remote device to retrieve information, while read/write access allows a remote device to modify settings.
5. Click **OK** to save and add the changes to the running configuration and close the dialog.
6. Refer to the **Status** field for the current state of the requests made from applet. This field displays error messages if something goes wrong in the transaction between the applet and the switch
7. Click **Cancel** to return back to the SNMP v1/v2 screen without implementing changes.

7.3.2 Configuring SNMP v3 Access

SNMP Version 3 (SNMPv3) adds security and remote configuration capabilities to previous versions. The SNMPv3 architecture introduces the *User-based Security Model* (USM) for message security and the *View-based Access Control Model* (VACM) for access control. The architecture supports the concurrent use of different security, access control, and message processing techniques.

Refer to the **v3** screen to review the current SNMP v3 configuration. An Existing User Name can be selected and edited, enabled or disabled. .

NOTE The SNMP undo feature is not supported in this product.

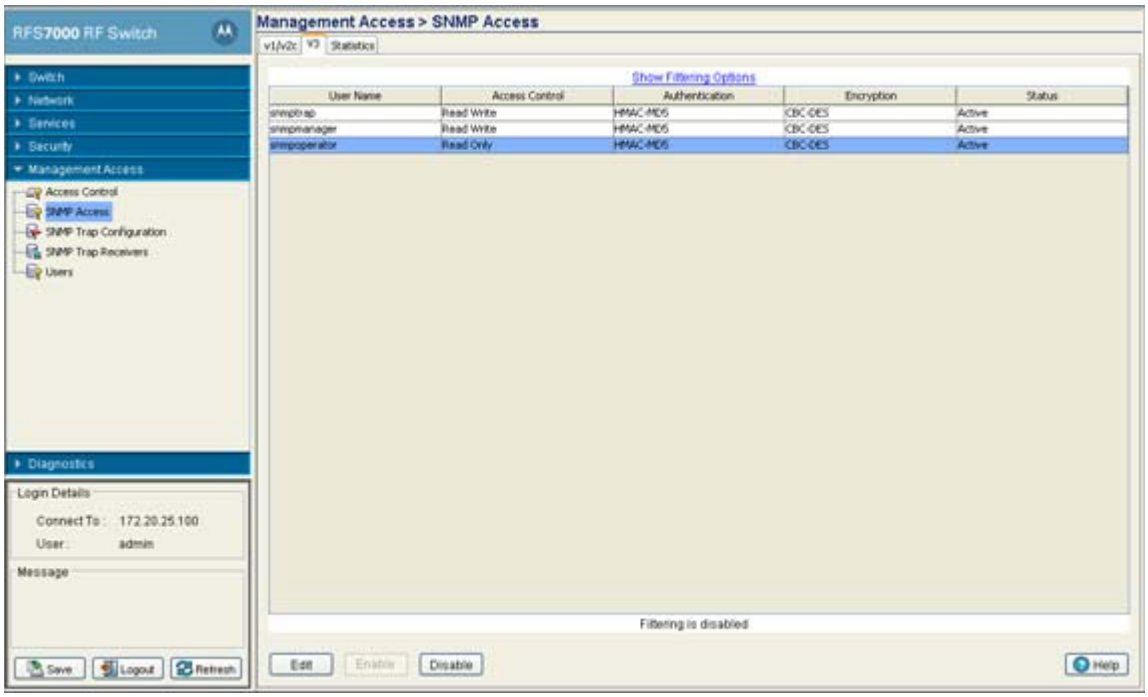
CAUTION The RFS7000 switch uses 3 unique (default) SNMPv3 user names and passwords for MD5 authentication and DES privacy.

username = snmpoperator/password = operator
username = snmpmanager/password = symboladmin
username = snmptrap/password = symboladmin

To review existing SNMP v3 definitions:

1. Select **Management Access** > **SNMP Access** from the main menu tree.

2. Select the **V3** tab from within the SNMP Access screen.



3. Refer to the fields within the V3 screen for the following information:

User Name	Displays a read-only SNMP v3 username of operator or Admin. An operator typically has an Access Control of read-only and an Admin typically has an Access Control of read/write.
Access Control	Displays a *read-only* (R) access or *read/write* (RW) access for the v3 user. Read-only access allows the user (when active) to retrieve information, while read/write access grants the user modification privileges.
Authentication	Displays the current authorization scheme used by this user for v3 access to the switch. Click the **Edit** button to modify the password required to change authentication keys.
Encryption	Displays the current *Encryption Standard* (DES) protocol the user must satisfy for SNMP v3 access to the switch. Click the **Edit** button to modify the password required to change encryption keys.
Status	Displays whether this specific SNMP v3 User Name is active on the switch. For more information, see *Accessing SNMP v2/v3 Statistics on page 7-9*.

4. Highlight an existing v3 entry and click the **Edit** button to modify the password for the Auth Protocol and Priv Protocol.

   For additional information, see *Editing an Existing SNMP v1/v2 Community Name on page 7-6*

5. Highlight an existing SNMP v3 User Name and click the **Enable** button to enable the log-in for the specified user. When selected the status of the user is defined as active.
6. Highlight an existing SNMP v3 User Name and click the **Disable** button to disable the log-in for the specified user. When selected the status of the user is defined as inactive.

7.3.2.1 Editing a SNMP v3 Authentication and Privacy Password

The **Edit** screen enables the user to modify the password required to change the authentication keys. Updating the password requires logging off of the system. Updating the existing password creates new authentication and encryption keys. To edit an SNMP v3 user profile:

1. Select **Management Access > SNMP Access** from the main menu tree.
2. Select the **v3** tab from within the SNMP Access screen.
3. Highlight an existing SNMP v3 User Name and click the **Edit** button.

   The **Authentication Protocol** is the existing protocol for the User Profile. The Authentication Protocol is not an editable option. The **Privacy Protocol** is the existing protocol for the User Profile. The Privacy Protocol is also not an editable option.
4. Enter the **Old Password** used to grant Authentication Protocol and Privacy Protocol permissions for the User Profile.
5. Enter the **New Password**, then verify the new password within the **Confirm New Password** area.
6. Click **OK** to save and add the changes to the running configuration and close the dialog.
7. Refer to the **Status** field for the current state of the requests made from applet. This field displays error messages if something goes wrong in the transaction between the applet and the switch.
8. Click **Cancel** to close the dialog without committing updates to the running configuration.

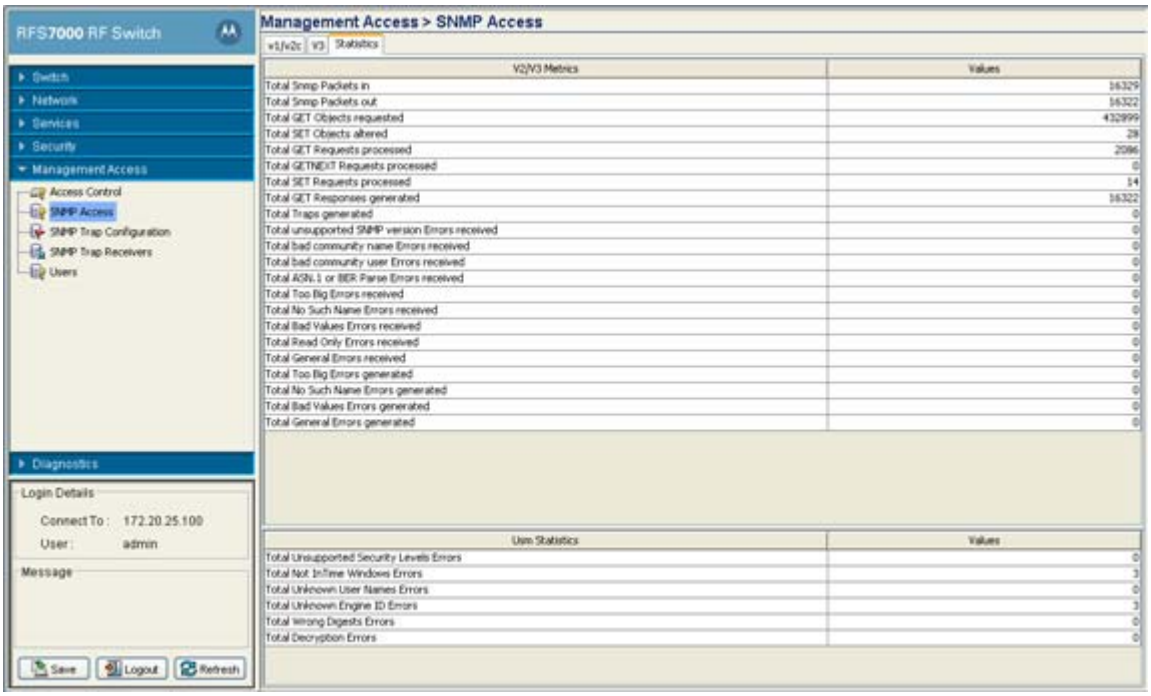
7.3.3 Accessing SNMP v2/v3 Statistics

Refer to the **Statistics** screen for a read-only overview of SNMP V2/V3 events and their current values. The screen also displays Usm Statistics (SNMP V3 specific events specific to the User-based Security Model) and their values.

To edit an SNMP v3 user profile:

1. Select **Management Access** > **SNMP Access** from the main menu tree.

2. Select the **Statistics** tab from within the SNMP Access screen.



3. Refer to the following read-only statistics displayed within the SNMP Access Statistics screen:

V2/V3 Metrics — Displays the individual SNMP Access events capable of having a value tracked for them. The metrics range from general SNMP events (such as the number of SNMP packets in and out) to specific error types that can be used for troubleshooting SNMP events (such as Bad Value and Read-Only errors).

Values — Displays the current numerical value for the SNMP V2/V3 Metric described on the left-hand side of the screen. The value equals the number of times the target event has occurred. This data is helpful in troubleshooting SNMP related problems within the network.

Usm Statistics — Displays SNMP v3 events specific to Usm. The *User-based Security Model* (USM) decrypts incoming messages. The module then verifies authentication data. For outgoing messages, the USM module encrypts PDUs and generates authentication data. The module then passes the PDUs to the message processor, which then invokes the dispatcher.

The USM module's implementation of the SNMP-USER-BASED-SM-MIB enables SNMP to issue commands to manage users and security keys. The MIB also enables the agent to ensure a requesting user exists and has the proper authentication information. When authentication is done, the request is carried out by the agent.

Values — Displays the current numerical value for the Usm Metric described on the left-hand side of the screen. The value equals the number of times the target event occurred. This data is helpful in troubleshooting Usm (Authentication and Encryption) related problems within the network.

7.4 Configuring SNMP Traps

Use the SNMP Trap Configuration screen to enable or disable individual traps or by functional trap groups. It is also used for modifying the existing threshold conditions values for individual trap descriptions. Refer to the tabs within the SNMP Trap Configuration screen to conduct the following configuration activities:

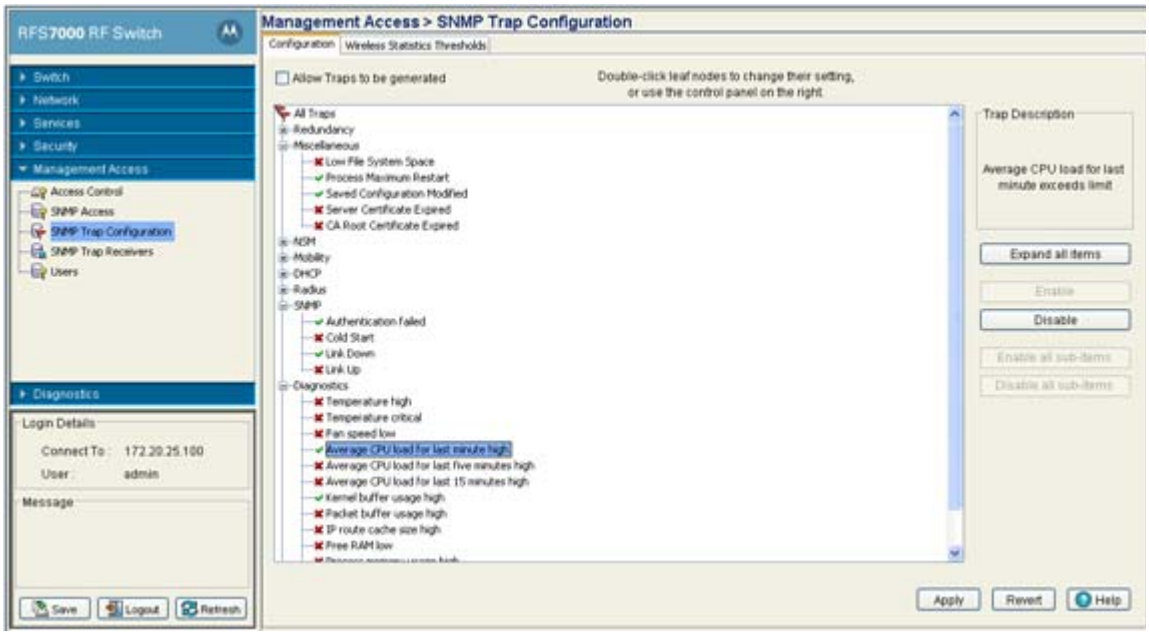
- *Enabling Trap Configuration*
- *Configuring Trap Thresholds*

7.4.1 Enabling Trap Configuration

If unsure whether to enable a specific trap, select it and view a brief description that may help your decision. Use **Expand all items** to explode each trap category and view all the traps that can be enabled. Traps can either be enabled by group or as individual traps within each parent category.

To configure SNMP trap definitions:

1. Select **Management Access** > **SNMP Trap Configuration** from the main menu tree.



2. Select the **Allow Traps to be generated** checkbox to enable the selection (and employment) of all the traps within the screen. Leaving the checkbox unselected means traps must be enabled by category or individually.
3. Refer to trap categories within the Configuration screen to determine whether traps should be enabled by group or individually enabled within parent groups.
4. Select an individual trap, by expanding the node in the tree view, to view a high-level description of this specific trap within the **Trap Description** field. You can also select a trap family category heading (such as "Redundancy" or "NSM") to view a high-level description of the traps within that trap category.

Redundancy	Displays a list of sub-items (trap options) specific to the Redundancy (clustering) configuration option. Select an individual trap within this subsection and click the **Enable** button to enable this specific trap or highlight the trap family parent item and click **Enable all sub-items** to enable all traps within the Cluster category.
Miscellaneous	Displays a list of sub-items (trap options) specific to the Miscellaneous configuration option (traps that do not fit in any other existing category). Select an individual trap within this subsection and click the **Enable** button to enable this specific trap or highlight the Miscellaneous trap family parent item and click **Enable all sub-items** to enable all traps within the Miscellaneous category.
NSM	Displays a list of sub-items (trap options) specific to the NSM configuration option. Select an individual trap within this subsection and click the **Enable** button to enable this specific trap or highlight the NSM trap family parent item and click **Enable all sub-items** to enable all traps within the NSM category.
Mobility	Displays a list of sub-items (trap options) specific to the Mobility configuration option. Select an individual trap within this subsection and click the **Enable** button to enable this specific trap or highlight the Mobility trap family parent item and click **Enable all sub-items** to enable all traps within the Mobility category.
DHCP	Displays a list of sub-items (trap options) specific to the DHCP configuration option. Select an individual trap within this subsection and click the **Enable** button to enable this specific trap or highlight the DHCP trap family parent item and click **Enable all sub-items** to enable all traps within the DHCP category.
Radius	Displays a list of sub-items (trap options) specific to the Radius configuration option. Select an individual trap within this subsection and click the **Enable** button to enable this specific trap or highlight the Radius trap family parent item and click **Enable all sub-items** to enable all traps within the Radius category.
SNMP	Displays a list of sub-items (trap options) specific to the SNMP configuration option. Select an individual trap within this subsection and click the **Enable** button to enable this specific trap or highlight the SNMP trap family parent item and click **Enable all sub-items** to enable all traps within the SNMP category.
Diagnostics	Displays a list of sub-items (trap options) specific to the Diagnostics configuration option. Select an individual trap within this subsection and click the **Enable** button to enable this specific trap or highlight the Diagnostics trap family parent item and click **Enable all sub-items** to enable all traps within the Diagnostics category.

Wireless	Displays the list of sub-items (trap options) specific to Wireless configuration. These include traps specific to wireless interoperability between the switch and its associated devices. Select an individual trap and click the **Enable** button to enable a specific trap or highlight the Wireless trap family parent item and click **Enable all sub-items** to enable all traps within the Wireless category.

5. Click the **Expand All Items** button to display the sub-items within each trap category. Use this item to display every trap that can be enabled.

   Once expanded, traps can then be enabled by trap category or individually within each trap category.
6. Highlight a specific trap and click the **Enable** button to enable this specific trap as an active SNMP trap.

   The items previously disabled (with an "X" to the left) now display with a check to the left of it.
7. Highlight a specific trap and click the **Disable** button to disable the item as an active SNMP trap.

   The items previously enabled (with a check to the left) now display with an "X" to the left of it.
8. Highlight a sub-menu header (such as Redundancy or Update Server) and click the **Enable all sub-items** button to enable the item as an active SNMP trap.

   Those sub-items previously disabled (with an "X" to the left) now display with a check to the left of them. Once the **Apply** button is clicked, the selected items are now active SNMP traps on the system.
9. Highlight a sub-menu header (such as Redundancy or SNMP) and click the **Disable all** sub-items button to disable the item as an active SNMP trap.

   Those sub-items previously enabled (with a check to the left) now display with an "X" to the left of them.
10. Click **Apply** to save the trap configurations enabled using the Enable or Enable all sub-items options.
11. Click **Revert** to discard any updates and revert back to its last saved configuration.

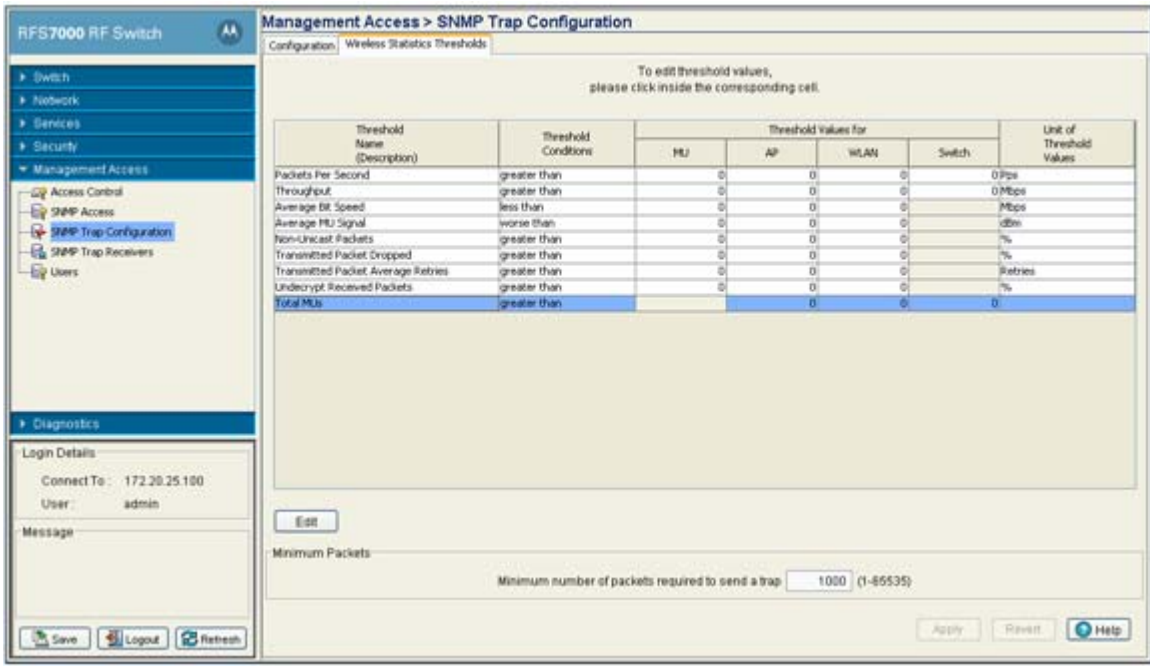
7.4.2 Configuring Trap Thresholds

Use the **Wireless Statistics Thresholds** screen to modify existing threshold conditions values for individual trap descriptions. Refer to the greater than, less than and worse than conditions to interpret how the values should be defined. Additionally, the Unit of threshold Values increment should be referenced to interpret the unit of measurement used.

To configure SNMP trap threshold values:

1. Select **Management Access** > **SNMP Trap Configuration** from the main menu tree.

2. Click the **Wireless Statistics Thresholds** tab.

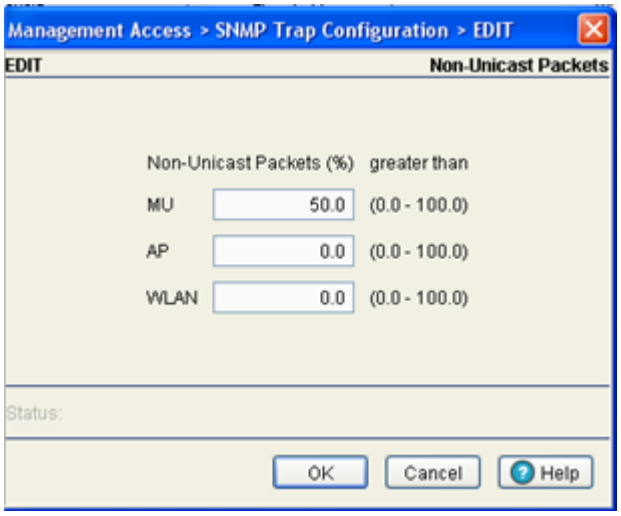


3. Refer to the following information for thresholds descriptions, conditions, editable threshold values and units of measurement.

Threshold Name (Description)	Displays the target metric for the data displayed to the right of the item. It defines a performance criteria used as a target for trap configuration.
Threshold Conditions	Displays the criteria used for generating a trap for the specific event. The Threshold conditions appear as greater than, less then or worse then and define a baseline for trap generation.
Threshold values for: MU	Displays a threshold value for associated MUs. Use the **Threshold Name** and **Threshold Conditions** as input criteria to define an appropriate Threshold Value unique to the MUs within the network. For information on specific values, see *Wireless Trap Threshold Values on page 7-15*.
Threshold values for: AP	Set a threshold value for adopted APs. Use the **Threshold Name** and **Threshold Conditions** as input criteria to define an appropriate Threshold Value unique to the APs within the network. For information on specific values, see *Wireless Trap Threshold Values on page 7-15*.
Threshold values for: WLAN	Define a threshold value for associated WLANs. Use the **Threshold Name** and **Threshold Conditions** as input criteria to define an appropriate Threshold Value unique to the WLANs within the network. For information on specific values, see *Wireless Trap Threshold Values on page 7-15*.
Threshold values for: Switch	Use the **Threshold Name** and **Threshold Conditions** as input criteria to define an appropriate Threshold Value unique to the switch. For information on specific values, see *Wireless Trap Threshold Values on page 7-15*.

Unit of Threshold Values	Displays the measurement value used to define whether a threshold value has been exceeded. Typical values include Mbps, retries and %. For information on specific values, see *Wireless Trap Threshold Values on page 7-15*.

4. Select a threshold and click the **Edit** button to display a screen wherein threshold settings for the MU, AP and WLAN can be modified. Each screen is slightly different as threshold parameters are unique.



   Adjust the values as needed (between 0 -100) to initiate a trap when the value is exceeded for the MU, AP or WLAN. Ensure the value set is realistic, in respect to the number of MUs and APs supporting WLANs within the switch managed network.

5. Use the **Maximum Number of Packets to Send a Trap** field (at the bottom of the screen) to enter a value used as the minimum number of data packets required for a trap to be generated for a target event. Ensure the value is realistic, as setting it to low could generate traps unnecessarily. Refer to *Wireless Trap Threshold Values on page 7-15* for additional information.
6. Click the **Apply** button to save changes made to the screen since the last saved configuration.
7. Click the **Revert** button to revert the screen back to its last saved configuration. Changes made since the contents of the screen were last applied are discarded.

7.4.2.1 Wireless Trap Threshold Values

The table below lists Wireless Trap threshold values:

Table 7.1 Wireless Traps Threshold values

#	***Threshold Name***	***Condition***	***Station Range***	***Radio Range***	***WLAN Range***	***Wireless Service Range***	***Units***
1	Packets per Second	Greater than	A decimal number greater than 0.00 and less than or equal to 100000.00	A decimal number greater than 0.00 and less than or equal to 100000.00	A decimal number greater than 0.00 and less than or equal to 100000.00	A decimal number greater than 0.00 and less than or equal to 100000.00	Pps

Table 7.1 Wireless Traps Threshold values

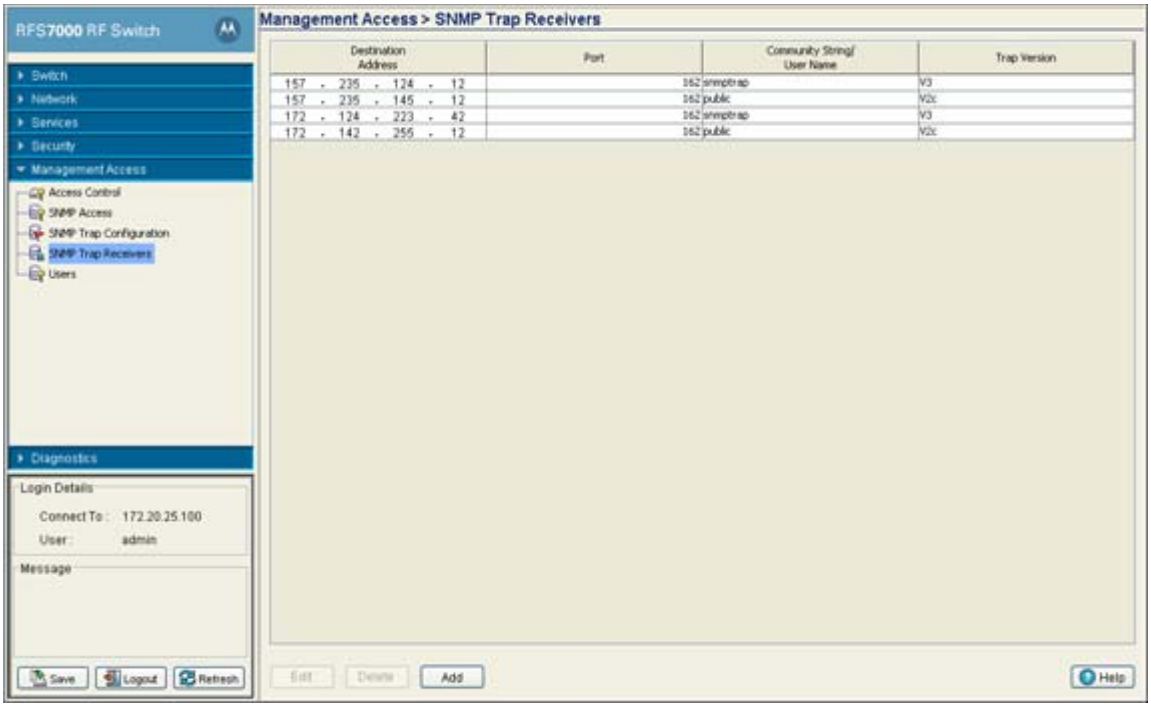
#	***Threshold Name***	***Condition***	***Station Range***	***Radio Range***	***WLAN Range***	***Wireless Service Range***	***Units***
2	Throughput	Greater than	A decimal number greater than 0.00 and less than or equal to 100000.00	A decimal number greater than 0.00 and less than or equal to 100000.00	A decimal number greater than 0.00 and less than or equal to 100000.00	A decimal number greater than 0.00 and less than or equal to 100000.00	Mbps
3	Average Bit Speed	Less than	A decimal number greater than 0.00 and less than or equal to 54.00	A decimal number greater than 0.00 and less than or equal to 54.00	A decimal number greater than 0.00 and less than or equal to 54.00	N/A	Mbps
4	Average MU Signal	Worse than	A decimal number less than -0.00 and greater than or equal to -120.00	A decimal number less than -0.00 and greater than or equal to -120.00	A decimal number less than -0.00 and greater than or equal to -120.00	N/A	dBm
5	Non Unicast Packets	Greater than	A decimal number greater than 0.00 and less than or equal to 100.00	A decimal number greater than 0.00 and less than or equal to 100.00	A decimal number greater than 0.00 and less than or equal to 100.00	N/A	%
6	Transmitted Packet dropped	Greater than	A decimal number greater than 0.00 and less than or equal to 100.00	A decimal number greater than 0.00 and less than or equal to 100.00	A decimal number greater than 0.00 and less than or equal to 100.00	N/A	%
7	Transmitted Packet Average retries	Greater than	A decimal number greater than 0.00 and less than or equal to 16.00	A decimal number greater than 0.00 and less than or equal to 16.00	A decimal number greater than 0.00 and less than or equal to 16.00	N/A	Retries
8	Undecrypted received packets	Greater than	A decimal number greater than 0.00 and less than or equal to 100.00	A decimal number greater than 0.00 and less than or equal to 100.00	A decimal number greater than 0.00 and less than or equal to 100.00	N/A	%
9	Total MUs	Greater than	N/A	N/A A decimal N/A in the range <1-1000>	N/A A decimal N/A in the range <1-1000>	A decimal number in the range <1-1000>	Count

7.5 Configuring SNMP Trap Receivers

Refer to the **Trap Receivers** screen to review the attributes of existing SNMP trap receivers (including destination address, port, community, retry count, timeout and trap version). A new v2c or v3 trap receiver can be added to the existing list by clicking the **Add** button.

To configure the attributes of SNMP trap receivers:

1. Select **Management Access > SNMP Trap Receivers** from the main menu tree.



2. Refer to the following SNMP trap receiver data to assess whether modifications are required.

Destination Address	The **Destination Address** defines the numerical (non DNS name) destination IP address for receiving traps sent by the SNMP agent.
Port	The **Port** specifies a destination *User Datagram Protocol* (UDP) receiving traps.
Community String/ User Name	Enter a **Community** name specific to the SNMP-capable client that receives the traps. The community name is *public*.
Trap Version	The **Trap Version** defines the trap version (v1/2 or v3) defined by the SNMP-capable client receiving the trap. A trap designation cannot be modified.

3. Highlight an existing Trap Receiver and click the **Edit** button to display a sub-screen used to modify the v2c or v3 Trap Receiver.

   Edit Trap Receivers as needed if existing trap receiver information is insufficient. You can only modify the IP address, port and v2c or v3 trap designation within the Edit screen. For more information, see *Editing SNMP Trap Receivers on page 7-18*.

4. Highlight an existing Trap Receiver and click the **Delete** button to remove the Trap Receiver from the list of available destinations available to receive SNMP trap information.

Remove Trap Receivers as needed if the destination address information is no longer available on the system.

5. Click the **Add** button to display a sub-screen used to assign a new Trap Receiver IP Address, Port Number and v2c or v3 designation to the new trap.

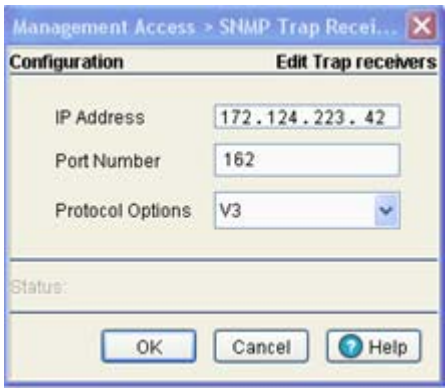
   Add trap receivers as needed if the existing trap receiver information is insufficient. For more information, see *Adding SNMP Trap Receivers on page 7-19*.

7.5.1 Editing SNMP Trap Receivers

Use the **Edit** screen to modify the trap receiver's IP Address, Port Number and v2c or v3 designation. Consider adding a new receiver before editing an existing one or risk overwriting a valid receiver. Edit existing destination trap receivers as required to suit the various traps enabled and their function in supporting the switch managed network.

To edit an existing SNMP trap receiver:

1. Select **Management Access > SNMP Trap Receivers** from the main menu tree.
2. Select (highlight) an existing SNMP trap receiver and click the **Edit** button.



3. Modify the existing address if it is no longer a valid address.

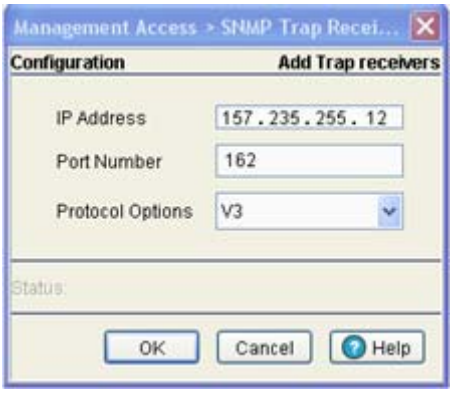
   If it is still a valid IP address, consider clicking the **Add** button from within the screen to add a new address without overwriting this existing one.
4. Define a **Port Number** for the trap receiver.
5. Use the **Protocol Options** drop-down menu to specify the trap receiver as either a SNMP v2c or v3 receiver.
6. Click **OK** to save and add the changes to the running configuration and close the dialog.
7. Refer to the **Status** field for the current state of the requests made from applet. This field displays error messages if something goes wrong in the transaction between the applet and the switch.
8. Click **Cancel** to close the dialog without committing updates to the running configuration.

7.5.2 Adding SNMP Trap Receivers

The SNMP **Add** screen is designed to create a new SNMP trap receiver. Use the Add screen to create a new trap receiver IP Address, Port Number and v2c or v3 designation. Add new destination trap receivers as required to suit the various traps enabled and their function in supporting the switch managed network.

To add a new SNMP trap receiver:

1. Select **Management Access > SNMP Trap Receivers** from the main menu tree.
2. Click the **Add** button at the bottom of the screen.



3. Create a new (non DNS name) destination IP address for the new trap receiver to be used for receiving the traps sent by the SNMP agent.
4. Define a **Port Number** for the trap receiver.
5. Use the **Protocol Options** drop-down menu to specify the trap receiver as either a SNMP v2c or v3 receiver.
6. Click **OK** to save and add the changes to the running configuration and close the dialog.
7. Refer to the **Status** field for the current state of the requests made from applet. This field displays error messages if something goes wrong in the transaction between the applet and the switch.
8. Click **Cancel** to close the dialog without committing updates to the running configuration.

7.6 Configuring Management Users

Refer to the **Users** screen to view the administrative privileges assigned to different switch users. You can modify the roles and access modes assigned to each user. The Users screen also allows you to configure the authentication methods used by the switch. Use this screen for the following permission configuration activities:

- *Configuring Local Users*
- *Configuring Switch Authentication*

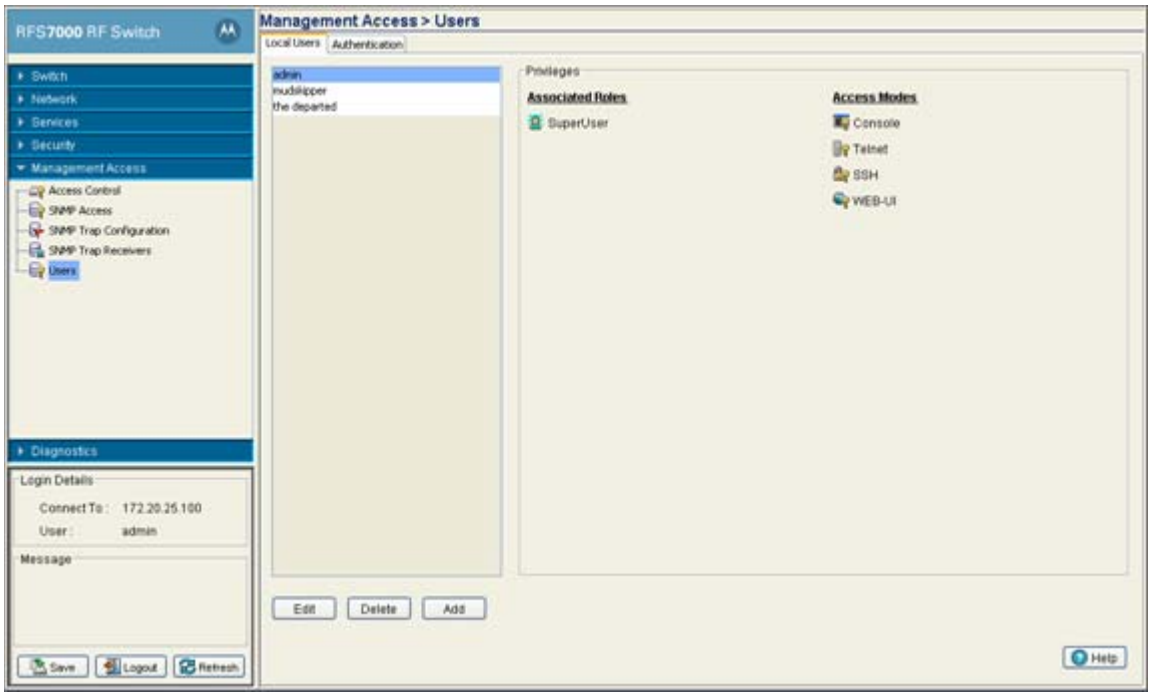
Additionally, the switch Web UI has the facility for creating guest administrators for creating guest users with defined login periods to specific guest groups. For more information, see *Creating a Guest Admin and Guest User on page 7-24*.

7.6.1 Configuring Local Users

Refer to the **Local Users** tab to view the administrative privileges assigned to users, create a new user and configure the associated roles and access modes assigned to each user.

To configure the attributes of Local User Details:

1. Select **Management Access** > **Users** from the main menu tree.
2. Click the **Local Users** tab.



The Local User window consists of 2 fields:

- *Users* – Displays the users currently authorized to use the switch. By default, the switch has two default user types, Admin and Operator.
- *Privileges* – Displays the privileges assigned to the user types.

3. Select the user (Admin, Operator or user defined) from the **Users** frame. The **Privilege** frame displays the rights authorized to the user.

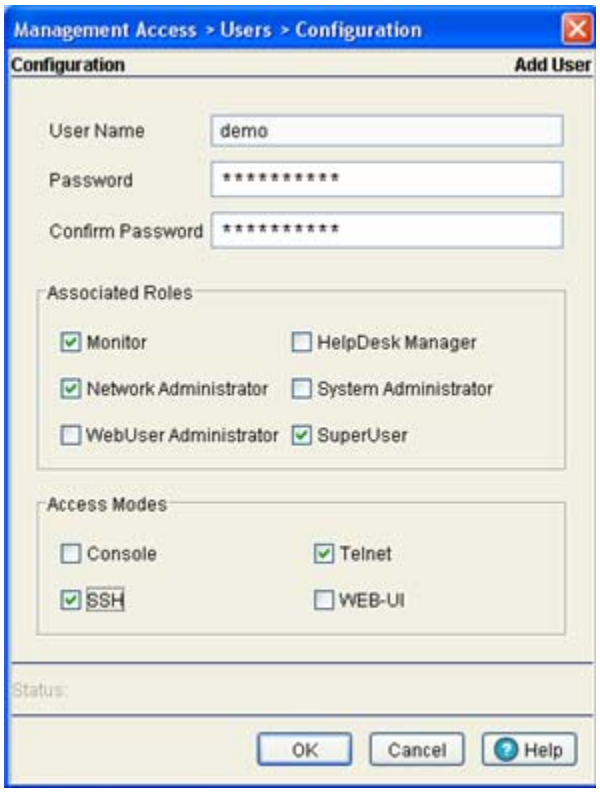
4. Click on the **Edit** button to modify the associated roles and access modes of the selected user. By default, the switch has two default users – Admin and Operator.
   Admin's role is that of a superuser and Operator the role will be monitored (read only).
5. Click on **Add** button to add and assign rights to a new user.
6. Click on **Delete** button to delete the selected user from the Users frame.

7.6.1.1 Creating a New Local User

Local users are those users connected directly into the switch and do not require any sort of configurable remote connection.

To create a new local user:

1. Select **Management Access** > **Users** from the main menu tree.
2. Click the **Add** button.



3. Enter the login name for the user in the **Username** field. Ensure this name is practical and identifiable to the user.
4. Enter the authentication password for the new user in the **Password** field and reconfirm the same again in the **Confirm Password** field.
5. Select the role you want to assign to the new user from the options provided in the **Associated Roles** panel. Select one or more of the following options:

   Monitor — Select **Monitor** to assign regular user permissions without any administrative rights. The Monitor option provides *read-only* permissions.

Help Desk Manager	Assign this role to someone who typically troubleshoots and debugs problems reported by the customer. The Help Desk Manager typically runs troubleshooting utilities (like a sniffer), executes service commands, views/retrieves logs and reboots the switch.
Network Administrator	The **Network Administrator** has privileges to configure all wired and wireless parameters like IP config, VLANs, L2/L3 security, WLANs, radios, IDS and hotspot.
System Administrator	Select **System Administrator** to allow the user to configure general settings like NTP, boot parameters, licenses, perform image upgrade, auto install, manager redundancy/clustering and control access.
Web User Administrator	Assign **Web User Administrator** privileges to add users for Web authentication (hotspot).
Super User	Select **Super User** to assign complete administrative rights.

NOTE There are some basic operations/CLI commands (exit, logout and help) available to all user roles. All the roles except Monitor can perform Help Desk role operations.

NOTE By default, the switch is HTTPS enabled with a self signed certificate. This is required since the Web UI uses HTTPS for user authentication.

6. Select the access modes to assign to the new user from the options provided in the **Access Modes** panel. Select one or more of the following options:

Console	This option provides the new user access to the switch using the console.
SSH	This option provides the new user access to the switch using SSH.
Telnet	This option provides the new user access to the switch using a Telnet session.
Web-UI	This option provides the new user access to the switch through the Web UI (applet).

7. Refer to the **Status** field for the current state of the requests made from applet. This field displays error messages if something goes wrong in the transaction between the applet and the switch.
8. Click the **OK** button to create the new user.
9. Click **Cancel** to revert back to the last saved configuration without saving any of your changes.

7.6.1.2 Modifying an Existing Local User

To create a new local user:

1. Select **Management Access** > **Users** from the main menu tree.
2. Select a user from the Users list and click the **Edit** button.
3. The **Username** field is read-only field and displays the login name of the user.

4. Enter the new authentication password for the user in the **Password** field and reconfirm within the **Confirm Password** field.
5. Select the user role from the options provided in the **Associated Roles** field. Select one or more of the following options:

Monitor	If necessary, modify user permissions without any administrative rights. The Monitor option provides *read-only* permissions.
Help Desk Manager	Optionally assign this role to someone who typically troubleshoots and debugs problems reported by the customer. the Help Desk Manager typically runs troubleshooting utilities (like a sniffer), executes service commands, views/retrieves logs and reboots the switch.
Network Administrator	The **Network Administrator** provides configures all wired and wireless parameters like IP config, VLANs, L2/L3 security, WLANs, radios, IDS and hotspot.
System Administrator	Select **System Administrator** (if necessary) to allow the user to configure general settings like NTP, boot parameters, licenses, perform image upgrade, auto install, manager redundancy/ clustering and control access.
Web User Administrator	Assign **Web User Administrator** privileges (if necessary) to add users for Web authentication (hotspot).
Super User	Select **Super User** (if necessary) to assign complete administrative rights.

NOTE By default, the switch is HTTPS enabled with a self signed certificate. This is required since the applet uses HTTPS for user authentication.

NOTE There are some basic operations/CLI commands like exit, logout and help available to all user roles. All roles except Monitor can perform Help Desk role operations.

6. Select the access modes you want to assign to the user from the options provided in the **Access Modes** panel. Select one or more of the following options:

Console	Provides the new user access to the switch using the console (applet).
SSH	Provides the new user access to the switch using SSH.
Telnet	Provides the new user access to the switch using Telnet.
Applet	Provides the new user access to the switch using the Web UI (applet).

7. Refer to the **Status** field for an indication of any problems that may have arisen.

   The Status is the current state of the requests made from applet. This field displays error messages if something goes wrong in the transaction between the applet and the switch.
8. Click on **OK** to complete the modification of the users privileges.
9. Click **Cancel** to revert back to the last saved configuration without saving any of your changes.

7.6.1.3 Creating a Guest Admin and Guest User

Optionally, create a guest administrator for creating guest users with specific usernames, start and expiry times and passwords. Each guest user can be assigned access to specific user groups to ensure they are limited to just the group information they need, and nothing additional.

To create a guest administrator:

1. Select **Management Access** > **Users** from the main menu tree.
2. Click the **Add** button.

3. Enter the new guest-admin login name for the user in the **Username** field.
4. Enter the authentication password for the guest-admin in the **Password** field and reconfirm the same again in the **Confirm Password** field.
5. Assign the guest-admin **WebUser Administrator** access.

NOTE To create guest users, a guest administrator must be assigned a **WebUser Administrator** access mode. None of the other modes launch the required Guest User Configuration screen upon login.

When the guest-admin user logins, they are redirected to a **Guest User Configuration** screen, wherein start and end user permissions can be defined in respect to specific users.

6. Add guest users by name, start date and time, expiry date and time and user group.
7. Optionally, click the **Generate** button to automatically create a username and password for each guest user.
8. Repeat this process as necessary until all required guest users have been created with relevant passwords and start/end guest group permissions.

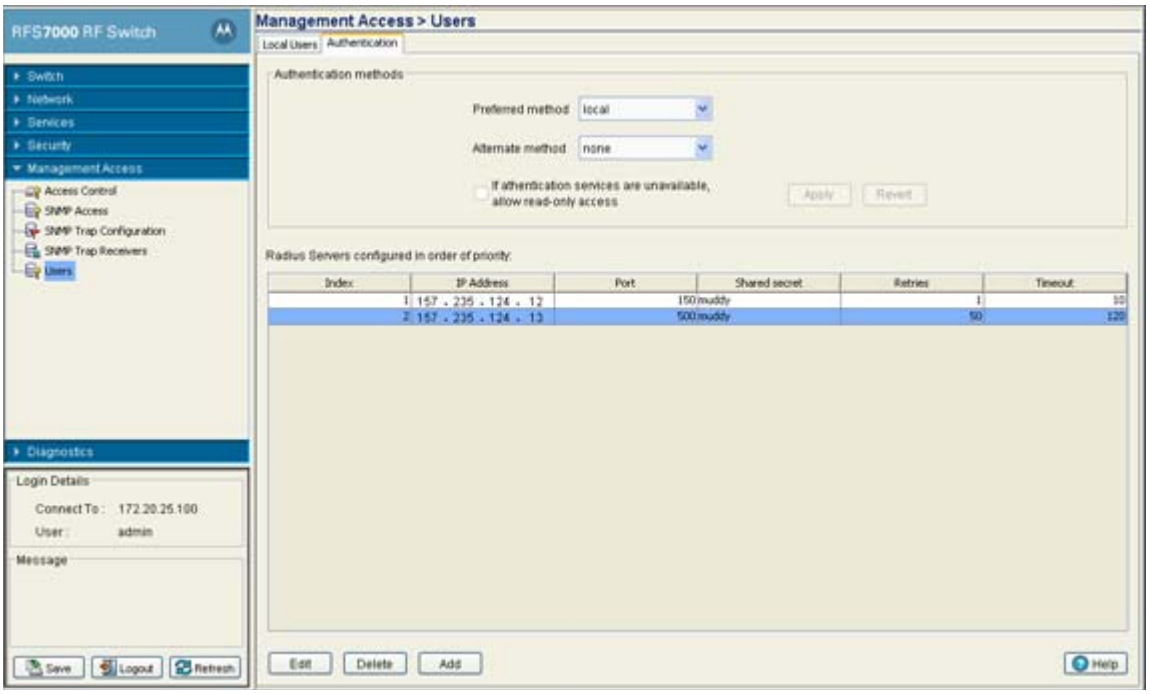
7.6.2 Configuring Switch Authentication

The switch provides the capability to proxy authenticate requests to a remote Radius server. Refer to the **Authentication** tab to view and configure the Radius Server used by the local user to log into the switch.

NOTE The Radius configuration described in this section is independent of other Radius Server configuration activities performed using other parts of the switch.

1. Select **Management Access** > **Users** from the main menu tree.

2. Select the **Authentication** tab.



3. Refer to the **Authentication methods** field to set a preferred and alternative authentication method:

Preferred Method — Select the preferred method for authentication. Options include:

- *None* - No authentication
- *Local* - The user employs a local user authentication resource. This is the default setting.
- *Radius* - Uses an external Radius Server.

Alternate Method — Select an alternate method for authentication. This drop-down menu will not list the option already selected as the preferred method. Select any of the remaining authentication methods as an alternate method.

If **authentication services are not available** (for whatever reason), select this checkbox for read-only access.

4. Click the **Apply** button to commit the authentication method for the switch.
5. Click the **Revert** button to rollback to the previous authentication configuration.
6. Refer to the bottom half of the Authentication screen to view the Radius Servers configured for switch authentication. The servers are listed in order of their priority.

Index — Displays a numerical **Index** for the Radius Server to help distinguish this Radius Server from other servers with a similar configuration. The maximum number that can be assigned is 32.

IP Address — Displays the IP address of the external Radius server. Ensure this address is a valid IP address and not a DNS name.

Port — Displays the TCP/IP port number for the Radius Server. The port range available for assignment is from 1 - 65535.

Shared secret	Displays the shared secret used to verify Radius messages (with the exception of the Access-Request message) are sent by a Radius-enabled device configured with the same shared secret. The shared secret is a case-sensitive string (password) that can include letters, numbers, or symbols. Ensure the shared secret is at least 22 characters long to protect the Radius server from brute-force attacks.
Retries	Displays the maximum number of times the switch can retransmit a Radius Server frame before it times out of the authentication session.
Timeout	Displays the maximum time (in seconds) the switch waits for the Radius Server's acknowledgment of authentication request packets before the switch times out of the session.

7. Select a Radius server from the table and click the **Edit** button to modify how the authentication method is used. For more information, see *Modifying the Properties of an Existing Radius Server on page 7-27*.
8. Highlight a Radius Server from those listed and click the **Delete** button to remove the server from the list of available servers.
9. Click the **Add** button at the bottom of the screen to display a sub-screen used to add a Radius Server to the list of servers available to the switch. For more information, see *Adding a New Radius Server on page 7-28*.

7.6.2.1 Modifying the Properties of an Existing Radius Server

Some of the attributes of an existing Radius Server can be modified by the switch to better reflect the Radius Server's existing connection with the switch.

To modify the attributes of an existing Radius Server:

1. Select **Management Access** > **Users** from the main menu tree.

   The Users screen displays.
2. Select the **Authentication** tab.
3. Select an existing Radius Server from those listed and click the **Edit** button at the bottom of the screen.
4. Modify the following Radius Server attributes as necessary:

Radius Server Index	Displays the read-only numerical **Index** value for the Radius Server to help distinguish this server from other servers with a similar configuration (if necessary). The maximum number that can be assigned is 32.
Radius Server IP Address	Modify the IP address of the external Radius server (if necessary). Ensure this address is a valid IP address and not a DNS name.
Radius Server Port	Change the TCP/IP port number for the Radius Server (if necessary). The port range available for assignment is from 1 - 65535.
Number of retries to communicate with Radius Server	Revise (if necessary) the maximum number of times the switch retransmits a Radius Server frame before it times out of the authentication session. The available range is between 0 - 100.

Time to wait for Radius Server to reply	Revise (if necessary) the maximum time (in seconds) the switch waits for the Radius Server's acknowledgment of authentication request packets before the switch times out of the session. The configurable range is between 1 - 1000 seconds.
Encryption key shared with Radius Server	Enter the encryption key the switch and Radius Server share and must validate before the user authentication scheme provided by the Radius Server can be initiated.

5. Refer to the **Status** field for the current state of the requests made from applet. This field displays error messages if something goes wrong in the transaction between the applet and the switch.
6. Click on **OK** to complete the modification of the Radius Server.
7. Click **Cancel** to revert back to the last saved configuration without saving any of your changes.

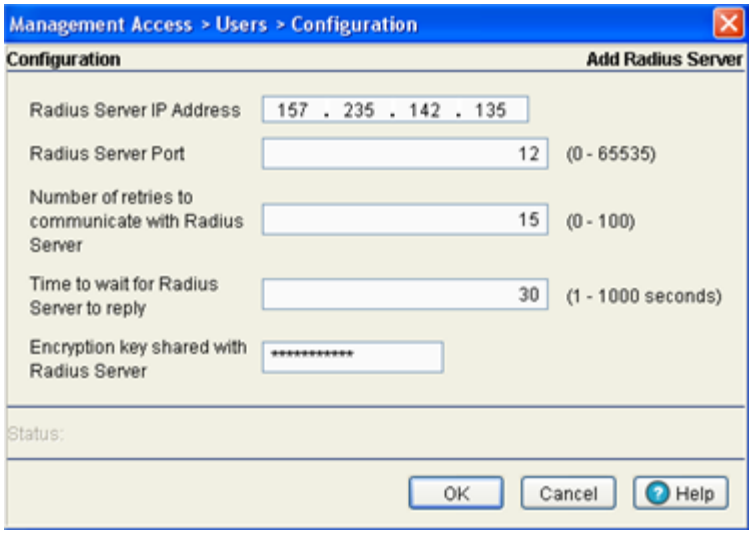
7.6.2.2 Adding a New Radius Server

The attributes of a new Radius Server can be defined by the switch to provide a new user authentication server. Once the server is configured and added, it displays within the Authentication tab as an option available to the switch.

To define the attributes of a new Radius Server:

1. Select **Management Access** > **Users** from the main menu tree.

   The Users screen displays.
2. Click on the **Authentication** tab.
3. Click the **Add** button at the bottom of the screen.



4. Configure the following Radius Server attributes:

Radius Server IP Address	Provide the IP address of the external Radius server. Ensure this address is a valid IP address and not a DNS name.
Radius Server Port	Enter the TCP/IP port number for the Radius Server. The port range available for assignment is from 1 - 65535.
Number of retries to communicate with Radius Server	Enter the maximum number of times the switch can retransmit a Radius Server frame before it times out of the authentication session. The available range is between 0 - 100.

Time to wait for Radius Server to reply	Define the maximum time (in seconds) the switch waits for the Radius Server's acknowledgment of authentication request packets before the switch times out of the session. The configurable range is between 1 - 1000 seconds.
Encryption key shared with Radius Server	Enter the encryption key the switch and Radius Server share and must validate before the user based authentication provided by the Radius Server can be initiated.

5. Refer to the **Status** field for the current state of the requests made from applet. This field displays error messages if something goes wrong in the transaction between the applet and the switch.
6. Click on **OK** to complete the addition of the Radius Server.
7. Click **Cancel** to revert back to the last saved configuration without saving any of your changes.

8

Diagnostics

This chapter describes the various diagnostic features available for monitoring switch performance. This chapter consists of the following switch diagnostic activities:

- *Displaying the Main Diagnostic Interface*
- *Configuring System Logging*
- *Reviewing Core Snapshots*
- *Reviewing Panic Snapshots*
- *Debugging the Applet*
- *Configuring a Ping*

NOTE HTTPS must be enabled to access the switch applet. Ensure HTTPS access has been enabled before using the login screen to access the switch applet.

NOTE The *Motorola RF Management Software* is a recommended utility to plan the deployment of the switch and view its configuration once operational. Motorola RFMS can help optimize the positioning and configuration of a switch (and its associated access ports) and assist in the troubleshooting of performance issues as they are encountered in the field.

8.1 Displaying the Main Diagnostic Interface

Use the main diagnostic screen to monitor the following switch features:

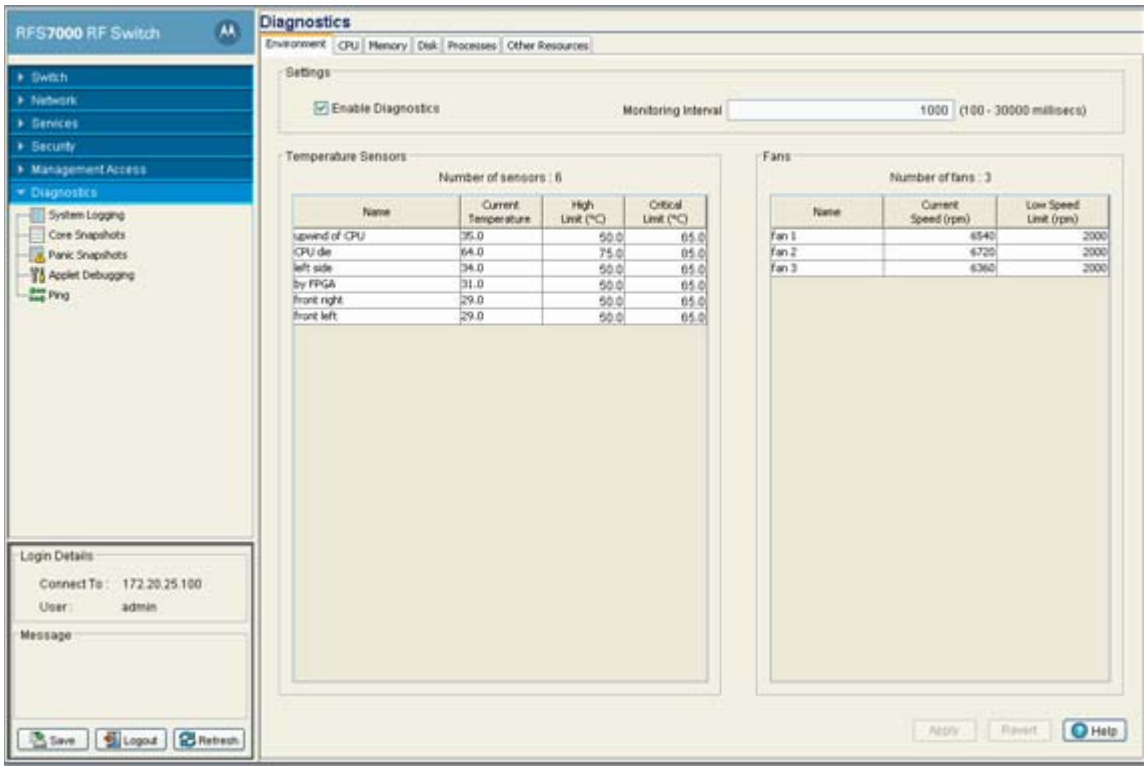
- *Switch Environment*
- *CPU Performance*
- *Switch Memory Allocation*
- *Switch Disk Allocation*
- *Switch Memory Processes*
- *Other Switch Resources*

NOTE When the switch's configuration is successfully updated (using the Web UI), the effected screen is closed without informing the user their change was successful. However, if an error were to occur, the error displays within the effected screen's Status field and the screen remains displayed. In the case of file transfer operations, the transfer screen remains open during the transfer operation and remains open upon completion (with status displayed within the Status field).

8.1.1 Switch Environment

Use the **Environment** tab to view and modify the switch diagnostic interval, temperature sensors and fan speeds.

1. Select **Diagnostics** from the main tree menu.
2. Select the **Environment** tab (opened by default).



3. The Environment displays the following fields:
   - *Settings*
   - *Temperature Sensors*
   - *Fans*
4. In the **Settings** field, select the **Enable Diagnostics** checkbox to enable/disable diagnostics and set the monitoring interval. The monitoring interval is the interval the switch uses to update the information displayed within the CPU, Memory, Disk, Processes and Other Resources tabs.

   Keep the monitoring interval at a shorter time increment when periods of heavy wireless traffic are anticipated.

NOTE Enabling switch diagnostics is recommended, as the diagnostics facilities provide detailed information on the physical performance of the switch and may provide indicators in advance of actual problems. Enabling diagnostics also assists in troubleshooting problems associated with data transfers and monitoring network traffic.

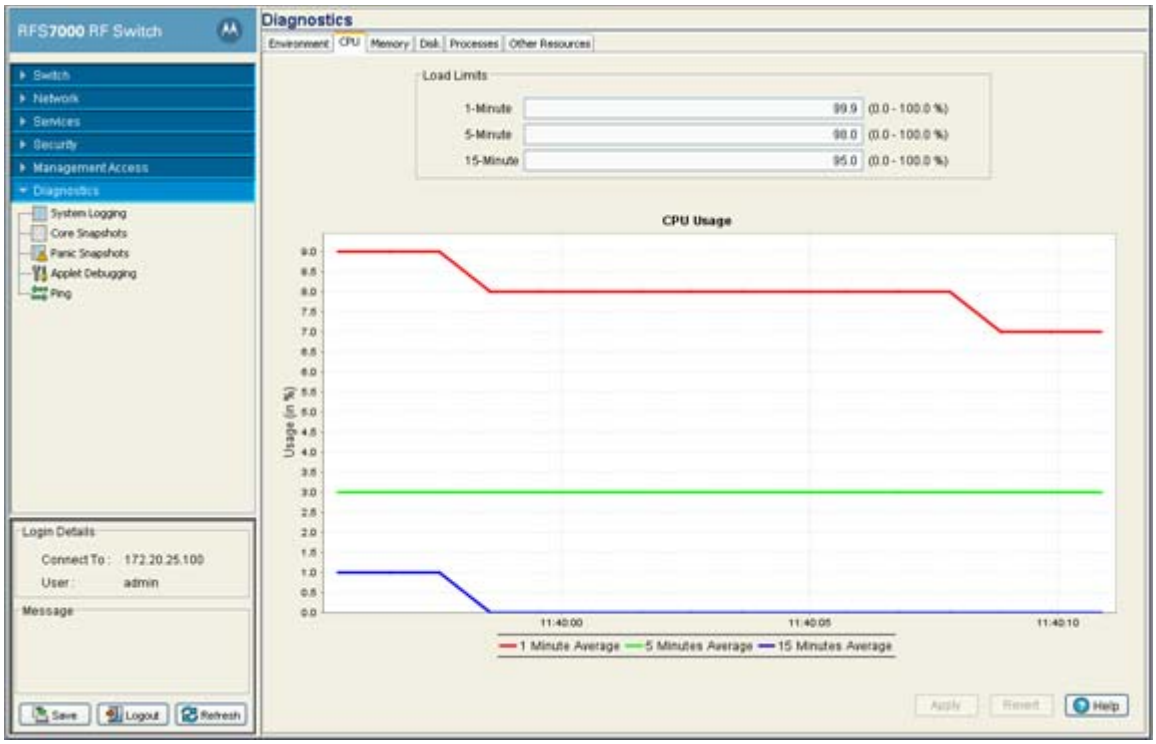
5. Use the **Temperature Sensors** field to monitor the CPU and system temperatures. This information is extremely useful in assessing if the switch exceeds its critical limits. Unlike a WS5100 Series Switch, an RF7000 Series Switch has six sensors.
6. Refer to the **Fans** field to monitor the CPU and system fan speeds. Unlike the WS5100 Series Switch, an RF7000 Series Switch has three fans.
7. Click on the **Apply** button to commit and apply the changes.
8. Click the **Revert** button to revert back to the last saved configuration.

8.1.2 CPU Performance

Use the **CPU** tab to view and define the CPU's load statistics. Load limits can be assessed for the last one minute, five minutes and 15 minutes to better gauge switch loads over differing periods of network activity.

1. Select **Diagnostics** from the main tree menu.

2. Select the **CPU** tab.



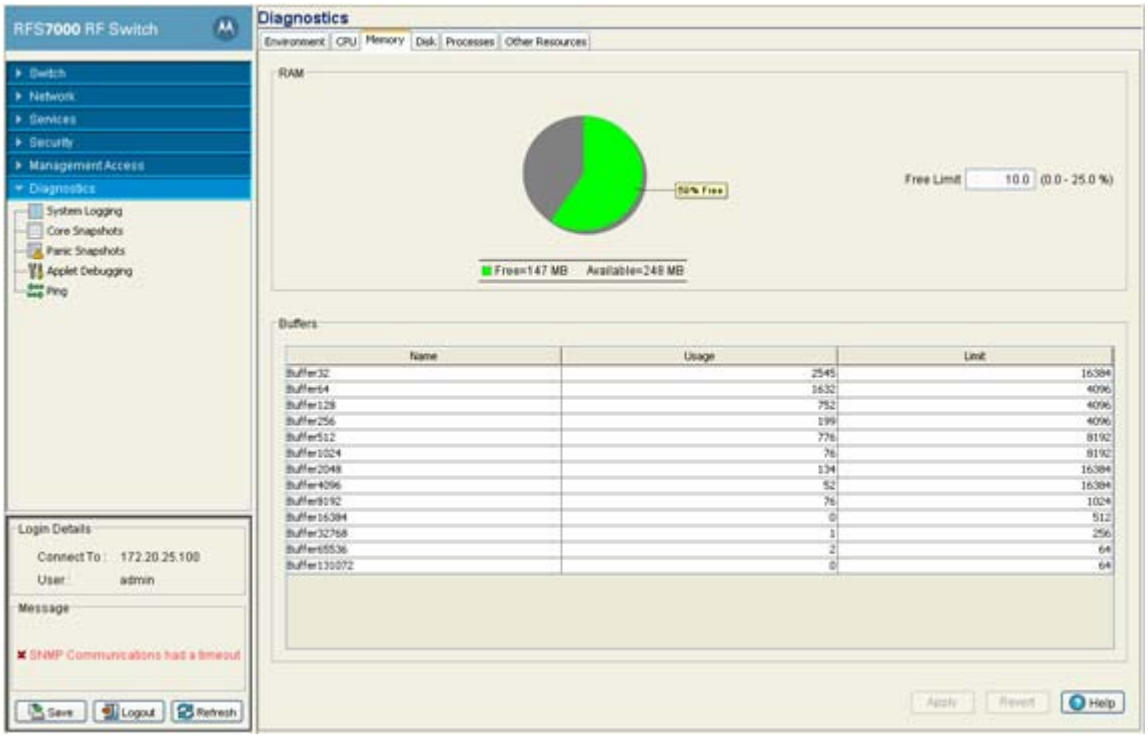
3. The CPU screen consists of 2 fields:
   - *Load Limits*
   - *CPU Usage*
4. The **Load Limits** field displays the maximum CPU load limits for the last 1, 5, and 15 minutes. The limits displayed coincide with periods of increased or decreased switch activity. The maximum CPU load threshold can be manually configured.
5. The **CPU Usage** field displays the real time CPU consumption values from the switch.

   Use this information to periodically determine if performance is negatively impacted by the overusage of switch CPU resources. If the CPU usage is substantial during periods of low network activity, then the situation requires troubleshooting.
6. Click the **Apply** button to commit and apply the changes.
7. Click the **Revert** button to revert back to the last saved configuration.

8.1.3 Switch Memory Allocation

Use the **Memory** tab to periodically assess the switch's CPU load.

1. Select **Diagnostics** from the main tree menu.
2. Select the **Memory** tab.



The Memory tab displays the following two fields:

- *RAM*
- *Buffer*

3. Refer to the **RAM** field to view the percentage of CPU memory in use (in a pie chart format).
4. Refer to the **Free Limit** value to change the CPUs memory allocation limits. Free Limit should be configured in respect to high bandwidth and increased load anticipated over the switch managed network.

5. The **Buffers** field displays buffer usage information. It consists of a table with the following information:

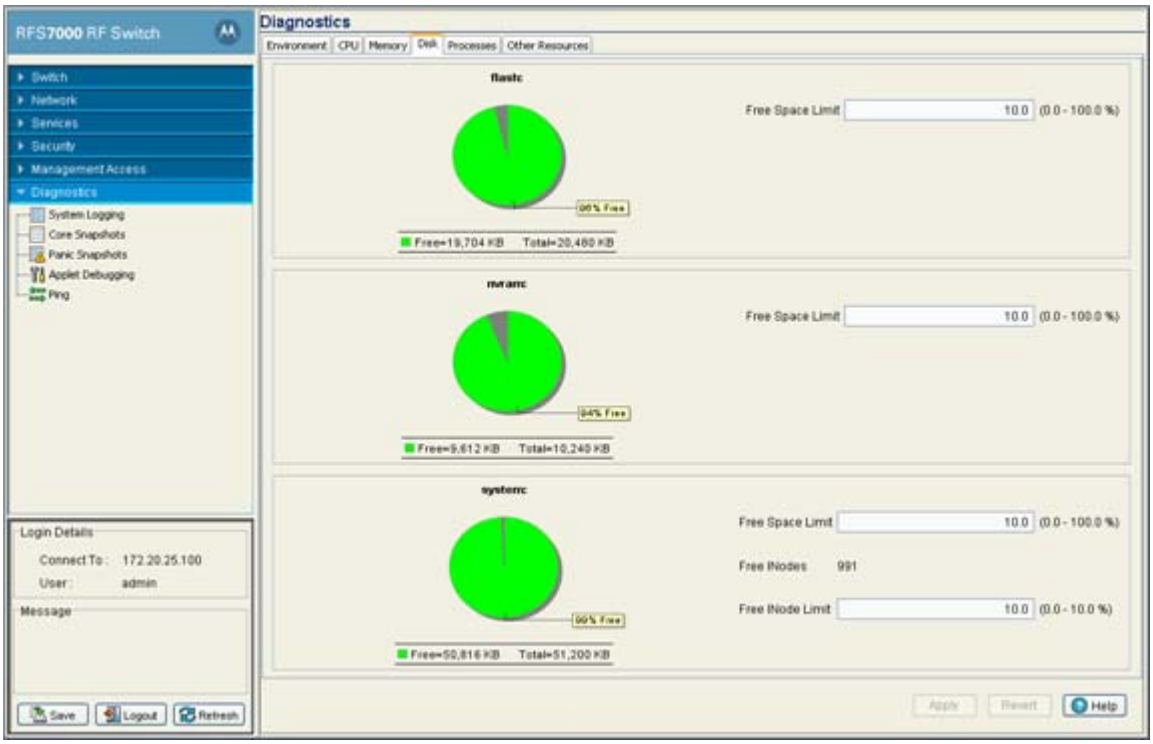
Name	The name of the buffer.
Usage	Buffers current usage
Limit	The buffer limit.

6. Click the **Apply** button to commit and apply the changes.
7. Click the **Revert b**utton to revert back to the last saved configuration.

8.1.4 Switch Disk Allocation

The **Disk** tab contains parameters related to the various disk partitions on the switch. It also displays available space in the external drives (compact flash etc).

1. Select **Diagnostics** from the main tree menu.
2. Select the **Disk** tab.

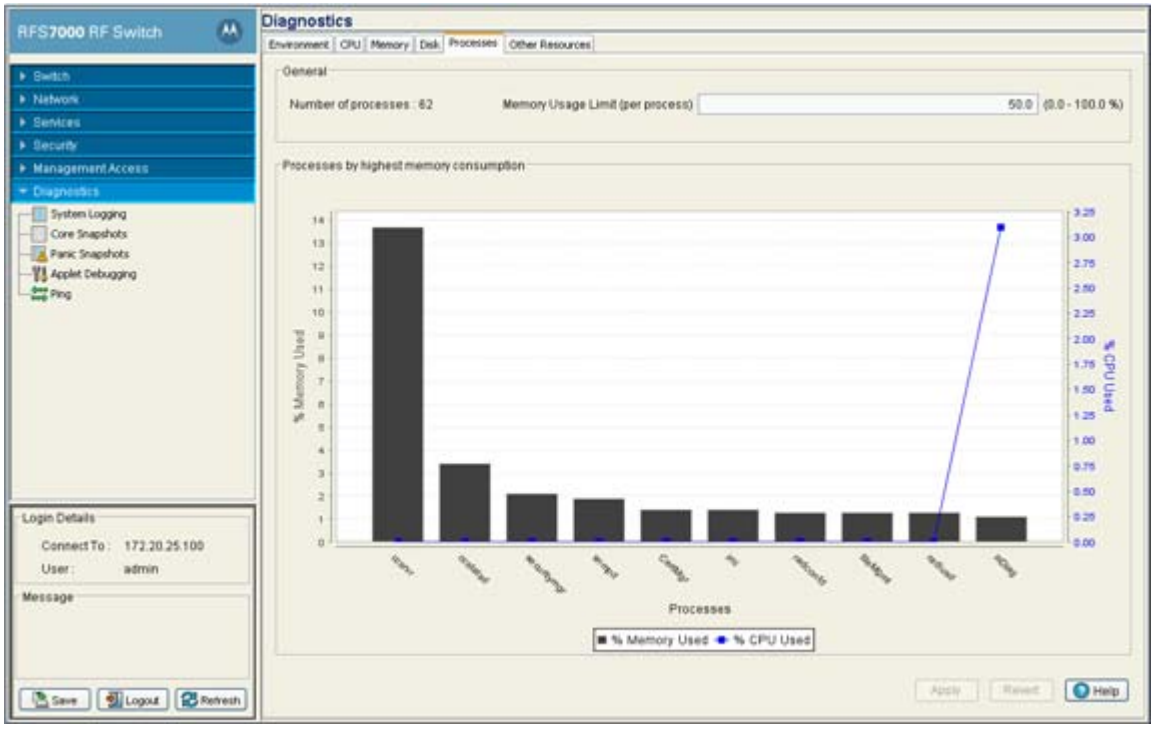


3. This Disk tab displays the status of the switch flash, nvram and system disk resources. Each field displays the following:
   - *Free Space Limit*
   - *Free INodes*
   - *Free INode Limit*
4. Use the **Free Limit Space** variable carefully, as disk space may be required during periods of high bandwidth traffic and file transfers.
5. Click the **Apply** button to commit and apply the changes.
6. Click the **Revert** button to revert back to the last saved configuration.

8.1.5 Switch Memory Processes

The **Processes** tab displays the number of processes in use and percentage of memory usage limit per process.

1. Select **Diagnostics** from the main tree menu.
2. Select the **Processes** tab

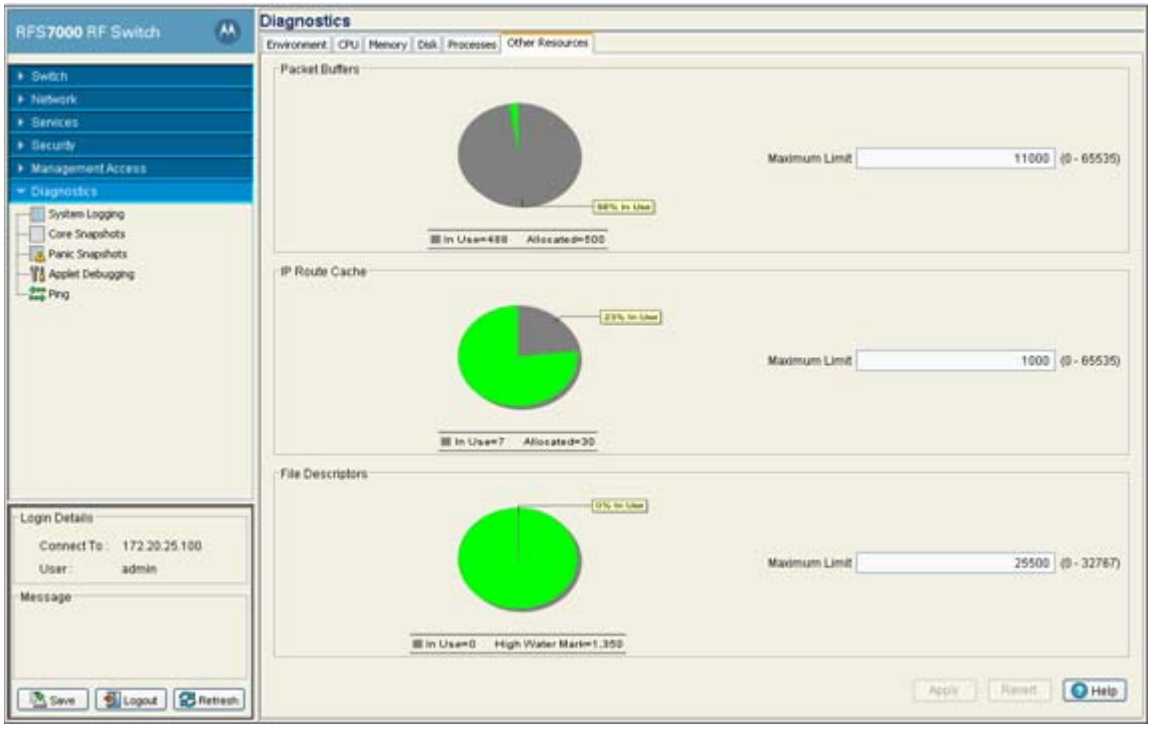


3. The Processes tab has 2 fields:
   - *General*
   - *Processes by highest memory consumption*
4. Refer to the **General** field to review the number of processes in use and percentage of memory usage per process. The value defined is the maximum limit per process during periods of increased and network activity and is negotiated amongst the other process as needed during normal periods of switch activity. Unlike the WS5100 Series Switch, an RF7000 Series Switch has 69 processes.
5. **Processes by highest memory consumption** displays a graph of the top ten switch processes based on memory consumption. Use this information to determine if a spike in consumption with the switch priorities in processing data traffic within the switch managed network.
6. Click the **Apply** button to commit and apply any changes to the memory usage limit.
7. Click the **Revert** button to revert back to the last saved configuration.

8.1.6 Other Switch Resources

The **Other Resources** tab displays the memory allocation of Packet Buffer, IP Route Cache and File Descriptors.

1. Select **Diagnostics** from the main tree menu.
2. Select the **Other Resources** tab.



Keep the Cache allocation in line with cache expectations required within the switch managed network.

3. Define the maximum limit for each resource accordingly as you expect these resources to be utilized within the switch managed network.
4. Click the **Apply** button to commit and apply any changes to any of the resources maximum limit.
5. Click the **Revert** button to revert back to the last saved configuration.

8.2 Configuring System Logging

Use the **System Logging** screen for logging system events. Its important to log individual switch events to discern an overall pattern that may be negatively impacting switch performance. The System Logging screen consist of the following tabs:

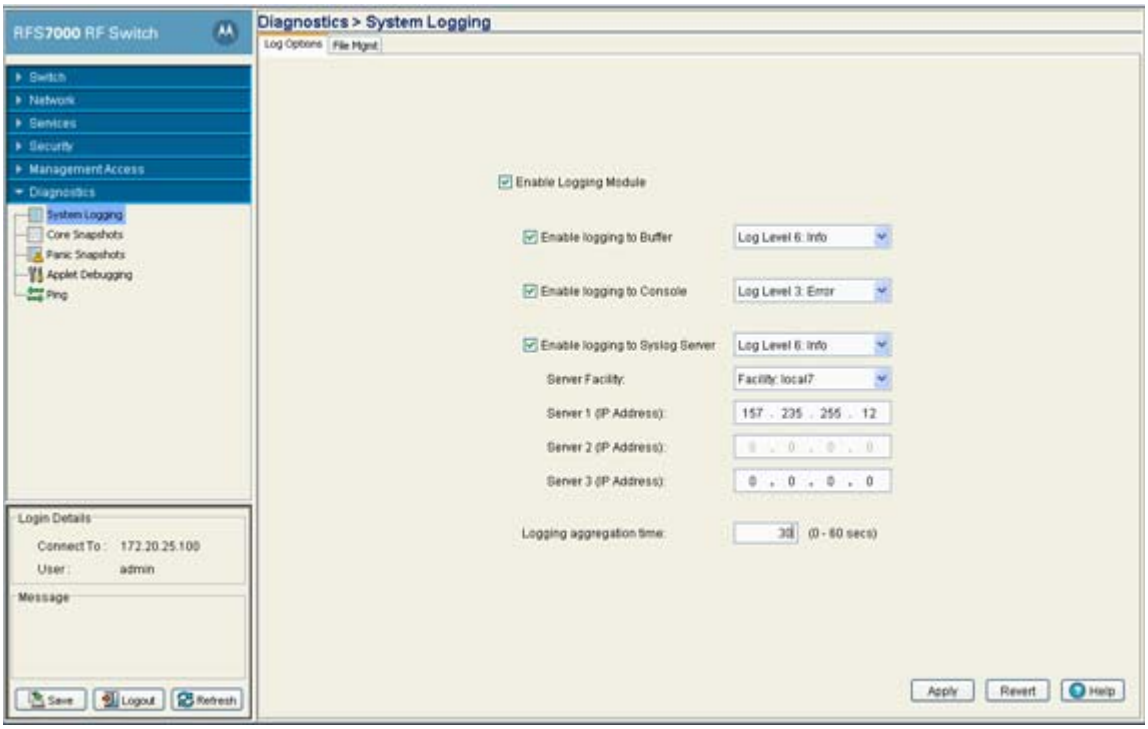
- *Log Options*
- *File Management*

8.2.1 Log Options

Use the Log Options tab to enable logging and define the medium used to capture system events and append them to the log file. Ensure the correct destination server address is supplied.

To view the Log options:

1. Select **Diagnostics** > **System Logging** from the main menu tree.
2. Select the **Log Options** tab.



3. Select the **Enable Logging Module** checkbox to enable the switch to log system events to a user defined log file or a syslog server.
4. Select the **Enable Logging to Buffer** checkbox to enable the switch to log system events to a buffer. Use the drop-down menu to select the desired log level for tracking system events to a local log file.

   The log levels are categorized by their severity. The default level is 3, (errors detected by the switch). However, more granular log levels can be selected for system level information detected by the switch that may be useful in assessing overall switch performance or troubleshooting.
5. Select the **Enable Logging to Console** checkbox to enable the switch to log system events to the system console. Use the drop-down menu to select the desired log level for tracking system events to a local log file.

6. Select the **Enable Logging to Syslog Server** checkbox to enable the switch to log system events send them to an external syslog server. Selecting this option also enables the Server Facility feature. Use the drop-down menu to select the desired log level for tracking system events to a local log file.
   a. Use the **Server Facility** drop-down menu to specify the local server facility (if used) for the transfer.
   b. Specify the numerical (non DNS name) IP address for the first choice syslog server to log system events in the **Server 1** field.
   c. Optionally, use the **Server 2** parameter to specify the numerical (non DNS name) IP address of an alternative syslog server if the first syslog server is unavailable.
   d. Optionally, use the **Server 3** parameter to specify the numerical (non DNS name) IP address of a third syslog server to log system events if the first two syslog servers are unavailable.

NOTE 255.255.255.255 is accepted as a valid entry for the IP address of a logging server.

7. Use the **Logging aggregation time** parameter to define the increment (or interval) system events are logged (0-60 seconds). The shorter the interval, the sooner the event is logged.
8. Click **Apply** to save the changes made to the screen. This will overwrite the previous configuration.
9. Click the **Revert** button to move the display back to the last saved configuration.

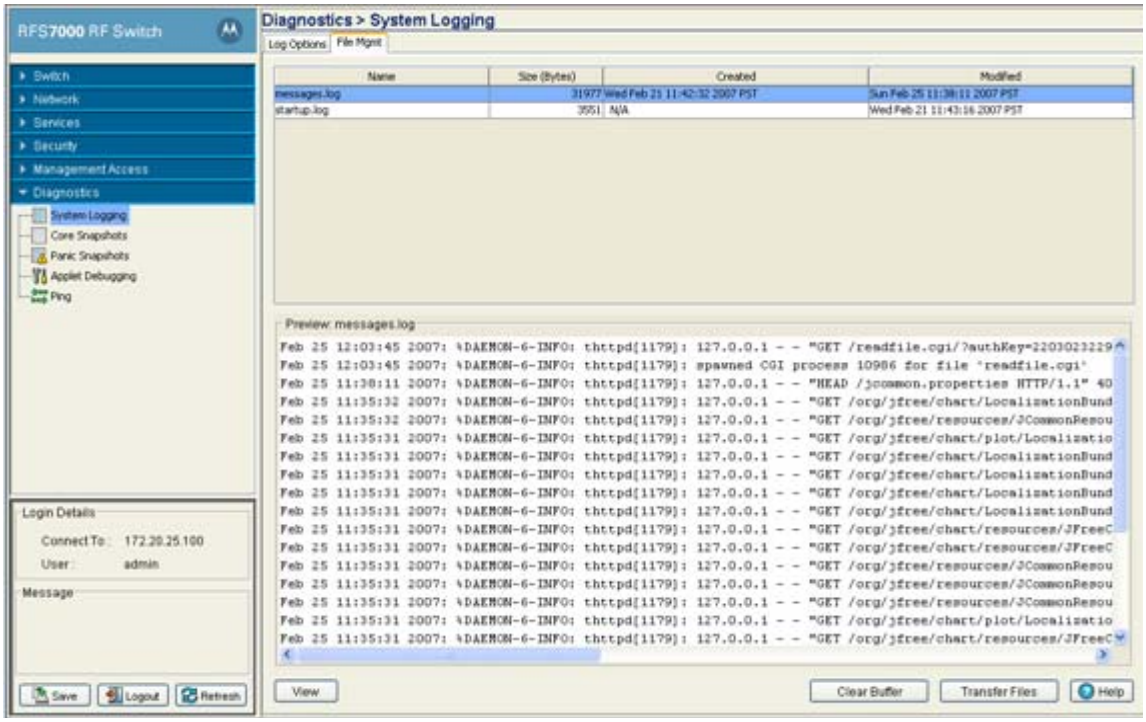
8.2.2 File Management

Use the **File Mgt** tab to view existing system logs. Select a file to display its details in the **Preview** field. Click the **View** button to display the file's entire contents. Once viewed, the user has the option of clearing the file or transferring the file to a user-defined location.

To view the Log options:

1. Select **Diagnostics** > **System Logging** from the main menu tree.

2. Select the **File Mgmt** tab.



3. The **File Mgmt** tab displays existing log files. Refer to the following for log file details:

Name	Displays a read-only list of the log files (by name) created since the last time the display was cleared. To define the type of log files created, click the **Log Options** tab to enable logging and define the log level.
Size (Bytes)	Displays the log file size in bytes. This is the current size of the file, if modifications were made, they have been accounted for.
Created	Displays the date, year and time of day the log file was initially created. This value only states the time the file was initiated, not the time it was modified or appended.
Modified	Displays the date, year and time of day the log file was modified since its initial creation date.

4. Highlight an existing log file to display the file's first page within the **Preview** field. Once a file is selected, its name is appended within the preview field, and its contents are displayed.

   The time, module, severity, mnemonic and description of the file are displayed.

5. Highlight a file from the list of log files available within the File Mgt tab and click the **View** button to display a detailed description of the entire contents of the log file.

   To view the entire content of an individual log file, see *Viewing the Entire Contents of Individual Log Files on page 8-12*.

6. Click the **Clear Buffer** button to remove the contents of the File Mgt tab. This is only recommended if you consider the contents of this file obsolete and wish to begin gathering new log file data.

   When the button is selected, a confirmation prompt displays verifying whether the contents of the log files is to be cleared.

7. Click the **Transfer Files** button to display a sub-screen wherein log files can be sent to an external location (defined by you) using a user-defined file transfer medium.

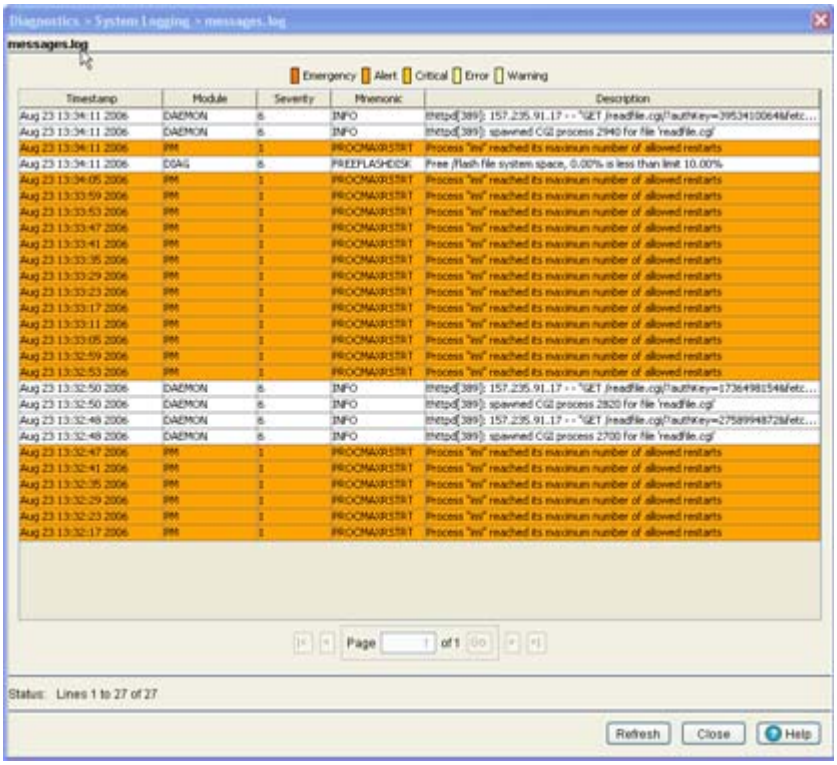
   Transferring files is recommended when the log file is frequently cleared, but an archive of the log files is required in a safe location. For more information on transferring individual log files, see *Transferring Log Files on page 8-14*.

8.2.2.1 Viewing the Entire Contents of Individual Log Files

Motorola recommends the entire contents of a log file be viewed to make an informed decision whether to transfer the file or clear the buffer. The **View** screen provides additional details about a target file by allowing the entire contents of a log file to be displayed and reviewed.

To display the entire contents of a log file:

1. Select **Diagnostics** > **System Logging** > **File Mgt** from the main menu tree.
2. Select an individual log file whose properties you wish to display in detail and click the **View** button.



3. Refer to the following for information on the elements that can be viewed within a log file:

Timestamp	Displays the date, year and time of day the log file was initially created. This value only states the time the file was initiated, not the time it was modified or appended.
Module	Displays the name of the switch logging the target event. This metric is important for troubleshooting issues of a more serious priority, as it helps isolate the switch resource detecting the problem.

Severity	The **Severity** level coincides with the logging levels defined within the Log Options tab. Use these numeric identifiers to assess the criticality of the displayed event. The severity levels include: • *0 - Emergency* • *1 - Alert* • *2 - Critical* • *3 - Errors* • *4 - Warning* • *5 - Notice* • *6 - Info* • *7 - Debug*
Mnemonic	Use the **Mnemonic** as a text version of the severity code information. A mnemonic is convention for the classification, organization, storage and recollection of switch information.
Description	Displays a high-level overview of the event, and (when applicable) message type, error or completion codes for further clarification of the event. Use this information for troubleshooting or for data collection.

4. Refer to the **Status** field for the current state of the requests made from applet. This field displays error messages if something goes wrong in the transaction between the applet and the switch.
5. Click the **Refresh** button to update the contents of the screen to the latest values.
6. Click the **Close** button to exit the screen. Clicking Close does not lose any data, as there are no values configured within this screen (it is view-only).

8.2.2.2 Transferring Log Files

If a system log contains data that may require archiving, consider using the **Transfer Files** screen to export the log file to an external location (that you designate) where there is no risk of deleting the contents of the log.

To transfer a log file to a user specified location:

1. Select **Diagnostics** > **System Logging** > **File Mgt** from the main menu tree.
2. Select a target log file to transfer and click the **Transfer File** button.

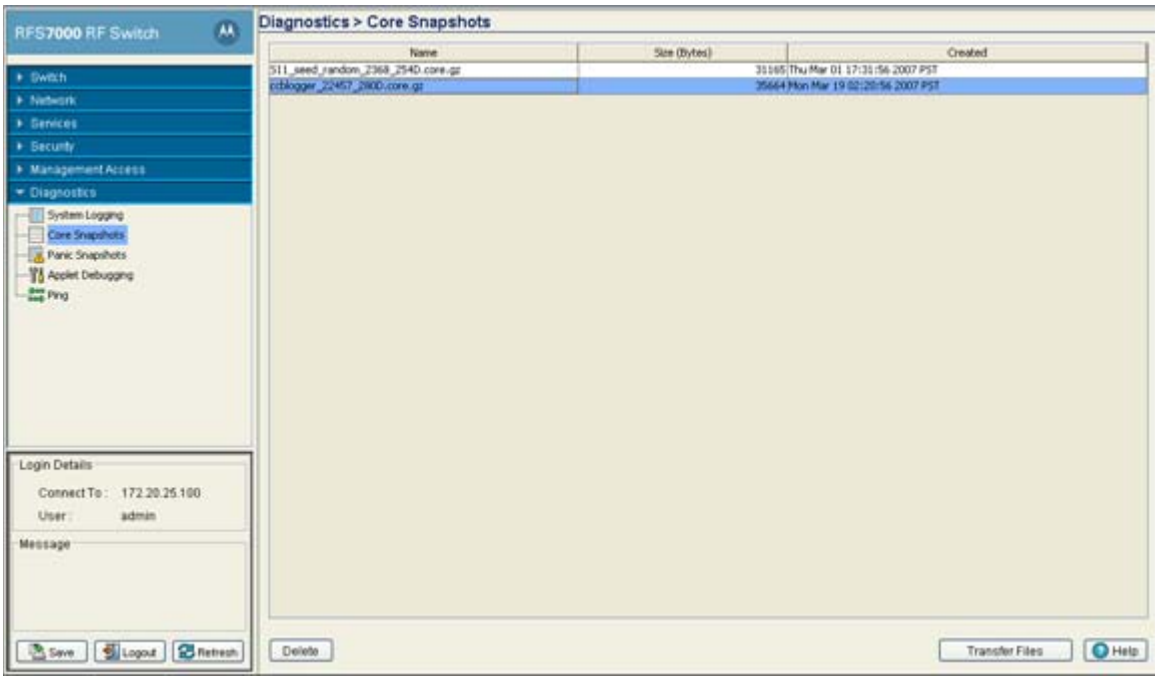
3. Use the **From** drop-down menu (within the Source field) to specify the location from which the log file is sent. If only the applet is available as a transfer location, use the default switch option.
4. Select a target file for transfer from the **File** drop-down menu. The drop-down menu contains the log files listed within the File-Mgmt screen.
5. Use the **To** drop-down menu (within the Target field) to define whether the target log file is to be sent to the system's local disk (Local Disk) or to an external server (Server).
6. Provide the name of the file to be transferred within the **File** parameter. Ensure the file name is correct.
7. If Server has been selected as the target use the **Using** drop down-menu to configure whether the log file transfer will be sent using FTP or TFTP.
8. If Server has been selected as the target, enter the **IP Address** of the destination server or system receiving the log file. Ensure the IP address is valid or risk jeopardizing the success of the log file transfer.
9. If Server has been selected as the target, enter the **User ID** credentials required to send the log file to the target location.
10. If Server has been selected as the target, use the **Password** parameter to enter the password required to send the log file to the target location.
11. Specify the appropriate **Path** name to the target directory on the local system disk or server as configured using the **To** parameter. If the local disk is selected, a browse button is available.
12. Click the **Transfer** button when ready to move the target file to the specified location. Repeat the process as necessary to move each desired log file to the specified location.
13. Refer to the **Status** field for the current state of the requests made from applet. This field displays error messages if something goes wrong in the transaction between the applet and the switch.
14. If a problem occurs during the file transfer, the process can be stopped by clicking the **Abort** button.
15. Click the **Close** button to exit the screen. No values need to be saved once the transfer has been made.

8.3 Reviewing Core Snapshots

Use the **Core Snapshots** screen to view the core snapshots (system events and process failures with a .core extension) logged by the system. Core snapshots are issues impacting switch core (or distribution layer). Once reviewed, core files can be deleted or transferred for archive.

To view the core snapshots available on the switch:

1. Select **Diagnostics** > **Core Snapshots** from the main menu tree.



2. Refer to the following table headings within the Core Snapshots screen:

Name	Displays the title of the process, process ID (pid) and build number separated by underscores. The file extension is always .core for core files.
Size (Bytes)	Displays the size of the core file in bytes.
Created	Displays the date and time the core file was generated. This information may be useful in troubleshooting issues.

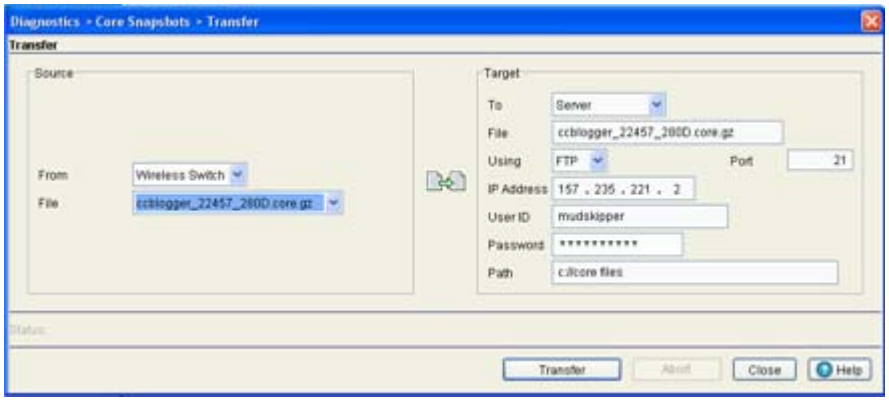
3. Select a target file and click the **Delete** button to remove the selected file. This option is not recommended until the severity of the core snapshot has been assessed.
4. Click the **Transfer Files** button to open the transfer dialogue to enable a file to be copied to another location. For more information on transferring core snapshots, see *Transferring Core Snapshots on page 8-16*.

8.3.1 Transferring Core Snapshots

Use the **Transfer** screen to define a source for transferring core snapshot files to a secure location for potential archive.

To transfer core snapshots to a user defined location:

1. Select **Diagnostics** > **Core Snapshots** from the main menu tree.
2. Select a target file, and select the **Transfer Files** button.



3. Use the **From** drop-down menu to specify the location from which the log file is sent.

   If only the applet is available as a transfer location, use the default switch option.
4. Select a target file for the file transfer from the **File** drop-down menu.

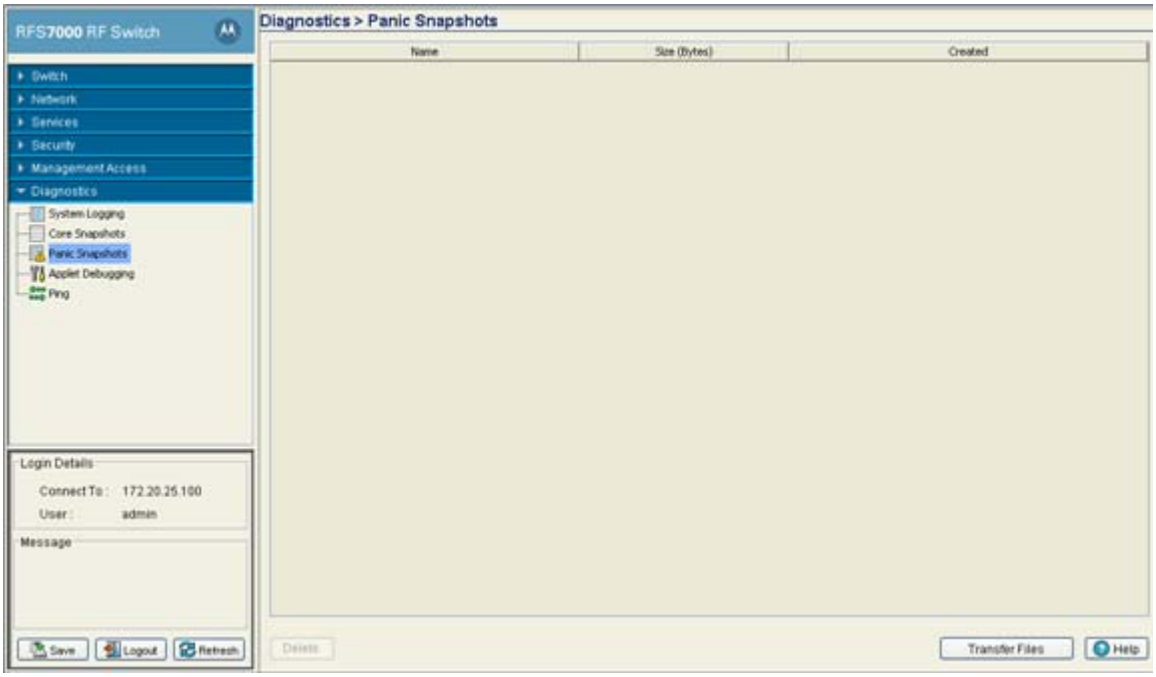
   The drop-down menu contains the core files listed within the File-Mgmt screen.
5. Use the **To** drop-down menu (within the Target field) to define whether the target log file is to be sent to the system's local disk (Local Disk) or to an external server (Server).
6. Provide the name of the file to be transferred to the location specified within the **File** field.
7. If Server has been selected as the target, use the **Using** drop down-menu to configure whether the log file transfer will be sent using FTP or TFTP.
8. If Server has been selected as the target, enter the **IP Address** of destination server or system receiving the target log file.
9. If Server has been selected as the target, enter the **User ID** credentials required to send the file to the target location. Use the user ID for FTP transfers only.
10. If Server has been selected as the target, enter the **Password** required to send the file to the target location using FTP.
11. Specify the appropriate **Path** name to the target directory on the local system disk or server as configured using the "To" parameter. If the local disk option is selected, use the browse button to specify the location on the local disk.
12. Refer to the **Status** field for the current state of the requests made from applet. This field displays error messages if something goes wrong in the transaction between the applet and the switch.
13. Click the **Transfer** button when ready to move the target file to the specified location. Repeat the process as necessary to move each desired log file to the specified location.
14. If a problem occurs during the file transfer, the process can be stopped by clicking the **Abort** button.
15. Click the **Close** button to exit the screen after a transfer. There are no changes to save or apply.

8.4 Reviewing Panic Snapshots

Refer to the **Panic Snapshots** screen for an overview of the panic files available. Typically, panic files refer to switch events interpreted as critical conditions (and thus requiring prompt attention). Use the information displayed within the screen to make informed decisions whether a target file should be discarded or transferred to a secure location for permanent archive.

To review the current panic snapshots on the switch:

1. Select **Diagnostics** > **Panic Snapshots** from the main menu.



2. Refer to the following table headings within the Panic Snapshots screen:

Name	Displays the title of the panic file. Panic files are named n.panic where n is in the range 0-9. 0 is always the oldest saved panic file and the highest number is the most recent. If the system experiences a panic, there are ten existing panics, the oldest is deleted and the remaining nine are renamed so the newest can be saved as 9.
Size (Bytes)	Displays the size of the panic file in bytes.
Created	Displays the date and time the panic file was created. The panic file is created after the system reboots, however the panic information within the file contains the date and time the panic actually occurred.

3. Refer to the **Preview** field for panic information in ASCII text. When a panic file is selected, the corresponding text is displayed in the preview screen and the name of the file displays. Use this information as a high-level overview of the panic.
4. Select a target panic file and click the **Delete** button to remove the file.
5. Select a target panic file and click the **View** button to open a separate viewing screen to display the panic information in greater detail. For more information, see *Viewing Panic Details on page 8-18*.

6. Click the **Transfer** button to open the transfer dialogue to transfer the file to another location. For more information, see *Transferring Panic Files on page 8-18*.

8.4.1 Viewing Panic Details

Use the **View** facility to review the entire contents of a panic snapshot before transferring or deleting the file. The view screen enables you to display the entire file.

To review Panic Snapshots:

1. Select **Diagnostics** > **Panic Snapshots** from the main menu.
2. Select a panic from those available and click the **View** button.
3. Refer to the following information to review the severity of a panic file:

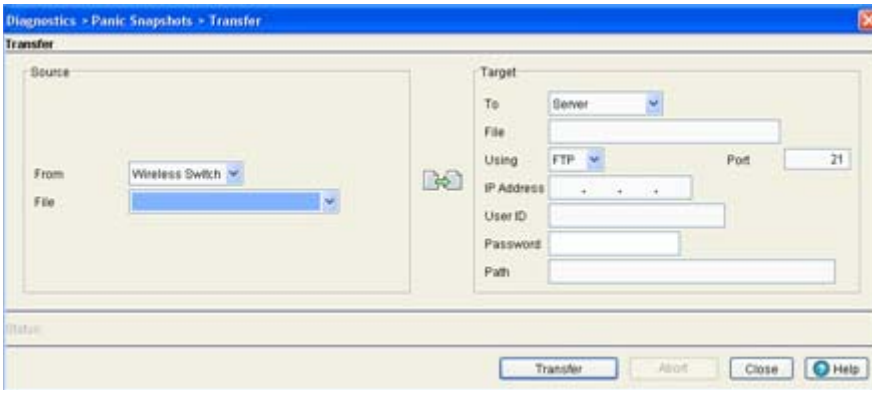
Main	The **Main** parameter displays detailed panic information for the selected file.
Page	Panic information may be spread across multiple pages. The Page value allows the user to view complete information on the panic. Use the < and > options to navigate through the contents of the file.
Refresh	Click the **Refresh** button to update the data displayed within the screen to the latest values.
Close	Click the **Close** button to exit the screen.

8.4.2 Transferring Panic Files

It is recommended panic snapshots files be kept in a safe location off the system used to create the initial files. Use the **Transfer Files** screen to specify a location where files can be archived without the risk of them being lost or corrupted.

For information on transferring panic files:

1. Select **Diagnostics** > **Panic Snapshots** from the main menu.
2. Select a record from those available and click the **Transfer** button.



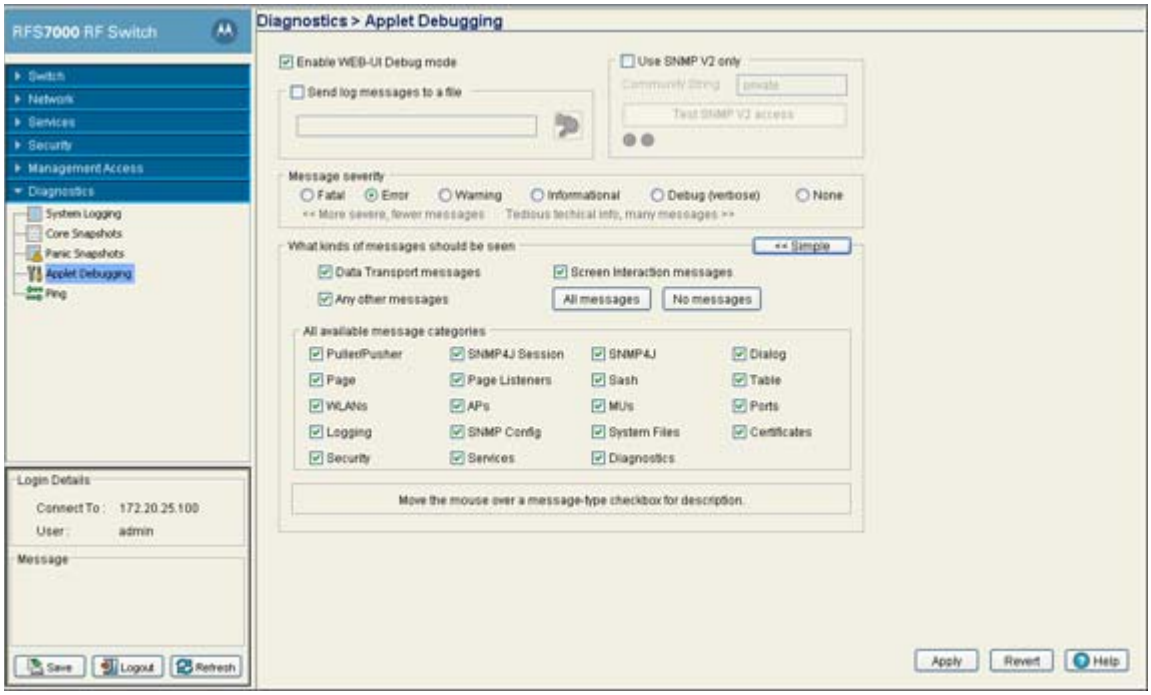
3. Use the **From** drop-down menu to specify the location from which the file is sent. If only the applet is available as a transfer location, use the default switch option.
4. Select a file for the file transfer from the **File** drop-down menu. The drop-down menu contains the panic files listed within the File-Mgmt screen.
5. Use the **To** drop-down menu (within the Target field) to define whether the target panic file is to be sent to the system's local disk (Local Disk) or to an external server (Server).

6. Provide the name of the file to be transferred to the location specified within the **File** field.
7. If Server has been selected as the target, use the **Using** drop down-menu to configure whether the panic file transfer will be sent using FTP or TFTP.
8. If Server has been selected as the target, enter the **IP Address** of destination server or system receiving the target panic file.
9. If Server has been selected as the target, enter the **User ID** credentials required to send the file to the target location. The User ID is required for FTP transfers only.
10. If Server has been selected as the target, enter the **Password** required (for FTP transfers) to send the file to the target location.
11. Specify the appropriate path name to the target directory on the local system disk or server as configured using the "To" parameter. If local server is selected, use the Browse button to specify a location on your local machine.
12. Refer to the **Status** field for the current state of the requests made from applet. This field displays error messages if something goes wrong in the transaction between the applet and the switch.
13. Click the **Transfer** button when ready to move the target file to the specified location. Repeat the process as necessary to move each desired log file to the specified location.
14. If a problem occurs during the file transfer, the process can be stopped by clicking the **Abort** button.
15. Click the **Close** button to exit the dialogue and abandon the transfer.

8.5 Debugging the Applet

Refer to the **Applet Debugging** screen to debug the applet. This screen allows you to view and debug system events by a criticality level you define.

1. Select **Diagnostics** > **Applet Debugging** from the main menu.



2. To use this window, select the **Enable Web-UI Debug Mode** checkbox.

   The Applet Debugging screen is partitioned into the following fields:

- *Send log message to a file.*
- *Use SNMP v2 only.*
- *Message severity.*
- *What kinds of messages should be seen.*

3. Select the **Send log message to a file** checkbox if you wish to store the log message.

   Enabling this checkbox allows you to select the file location where you wish to store the log message.

4. Select the **Use SNMP V2 only** checkbox to use SNMP v2 to debug the applet.

   Check whether you have access to SNMP v2 by clicking on the **Test SNMP V2 access** button. If SNMP v2 access is available, the test icon will change from grey to green, indicating the SNMPv2 interface is viable on the switch.

5. Select the severity of the message you wish to store in the log file.

   The **Message Severity** section allows you to report a bug and log it as per the following severity levels:

   - *Fatal* - loss of data or switch functionality
   - *Error* - switch data compilation problem, could result in data loss
   - *Warning* - potential data loss of configuration corruption
   - *Informational* - data that may be useful in assessing a potential error
   - *Debug* - information relevant to troubleshooting
   - *None* - no impact.

6. Select the message returned when a bug is raised.

   The **What Kind of message should be seen** field allows you to select a range of parameters for returned messages while debugging. Move your mouse pointer over a message checkbox for a message description.

   a. Click the **Advanced** button to display the entire list of message categories for when switch bugs are raised. Select the checkboxes corresponding to the message types you would like to receive.

      Each message category is enabled by default. Click the **Simple** button to minimize this area and hide the available message categories.

   b. Click the **All Messages** button to select all the message categories.

   c. Click the **No Messages** button if you do not want to select any of the message categories.

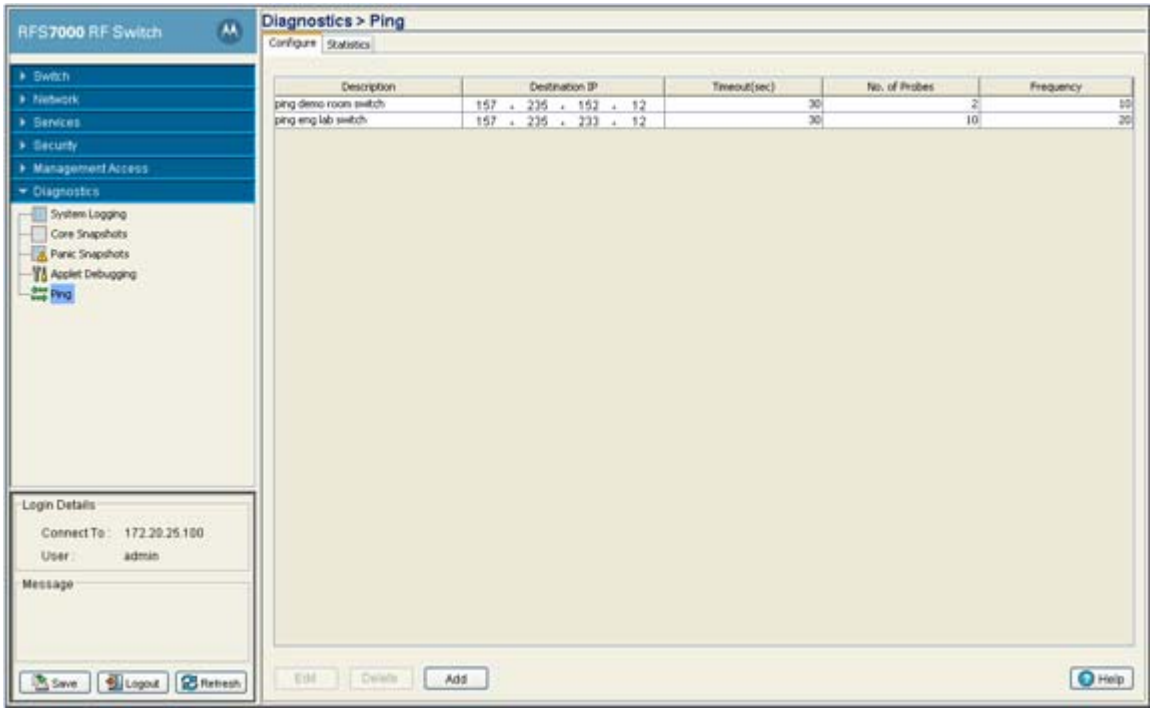
7. Click the **Apply** button to save the changes you have applied within this screen.
8. Click the **Revert** button to revert back to the last saved configuration.

8.6 Configuring a Ping

The switch can verify its link with other switches and associated MUs by sending ping packets to the associated device. Use a ping to test the connection between the switch and IP destinations you specify. For each ping packet transmitted, statistics are gathered for the *round-trip time* (RTT) between the switch and its destination. The RTT is the time (in milliseconds) for a ping packet to travel from the switch to its target destination and back again. This number can vary significantly due to the random nature of packet routings and random loads on the switch and its destination.

To view the switch's existing ping configuration:

1. Select **Diagnostics** > **Ping** from the main menu.



2. Refer to the following information displayed within the Configuration tab:

Description	Displays the user assigned description of the ping test. The name is read-only. Use this title to determine whether this test can be used as is or if a new ping test is required.
Destination IP	Displays the IP address of the target device. This is the numeric destination for the device sent the ping packets. If this address does not accurately reflect the ping destination target, the ping test will not be successful.
Timeout (sec)	Displays the timeout value (in seconds) used to timeout the ping test if a round trip packet is not received from the target device.
No. of Probes	Displays the number of packets transmitted to the target IP address to discern the round trip time between the switch and its connected device.
Frequency	Define the interval (in seconds) between ping packet transmissions. Define a longer interval if high levels of network congestion are anticipated between the switch and its target device. Use a value of 0 to execute a single ping test or stop a currently executing ping test.

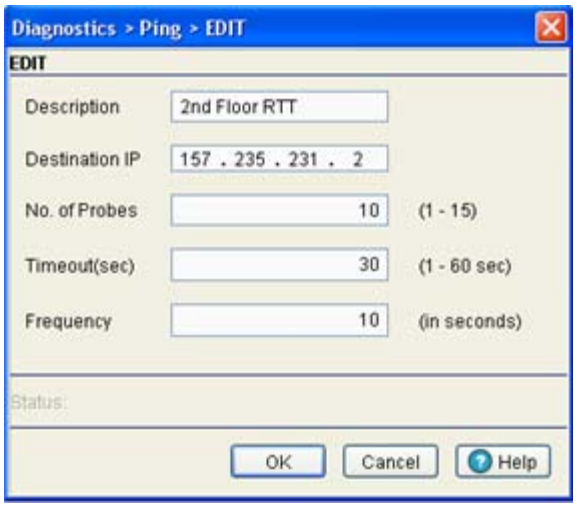
3. To edit the properties of an existing ping test, select a ping based on the description listed and click the **Edit** button. For more information, see *Modifying the Configuration of an Existing Ping Test on page 8-22*.
4. Select an existing ping test from those displayed within the Configure tab and click the **Delete** button to remove the ping test from those displayed.
5. Click the **Add** button to display a screen used to define the attributes of a new ping test. For more information, see *Adding a New Ping Test on page 8-23*.

8.6.1 Modifying the Configuration of an Existing Ping Test

The properties of an existing ping tests can be modified to ping an existing (known) device whose network address attributes may have changed and require modification to connect (ping) to it.

To modify the attributes of an existing ping test:

1. Select **Diagnostics** > **Ping** from the main menu.
2. Highlight an existing ping test within the Configuration tab and select the **Edit** button.



3. Modify the following information (as needed) to edit an existing ping test:

Description	If necessary, modify the description of the ping test. Ensure this description is representative of the test, as this is the description displaying within the Configuration tab.
Destination IP	If necessary, modify the IP address of the target device. This is the numeric (non DNS address) destination for the device transmitted the ping packets.
No. of Probes	If necessary, modify the number of packets transmitted to the target IP address to discern the round trip time between the switch and its connected device.
Timeout(sec)	If necessary, modify the timeout value (in seconds) used to timeout the ping test if a round trip packet is not received by the switch from its target device. Ensure this interval is long enough to account for network congestion between the switch and its target device.
Frequency	If necessary, modify the interval (in seconds) between ping packet transmissions. Define a longer interval if high levels of network congestion are anticipated between the switch and its target device. Use a value of 0 to execute a single ping or stop a currently executing ping test.

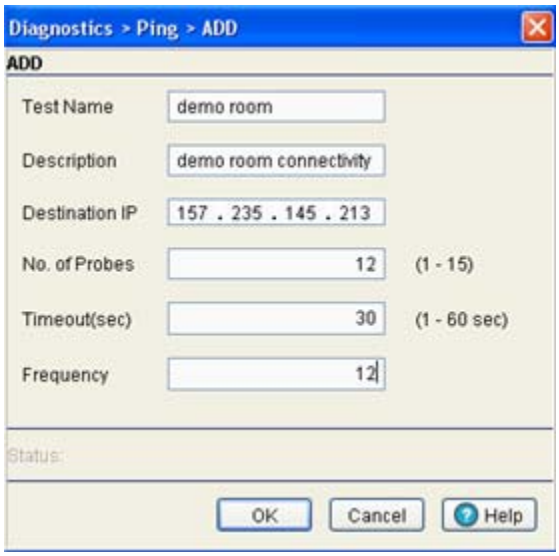
4. Click **OK** to save and add the changes to the running configuration and close the dialog.
5. Refer to the **Status** field for the current state of the requests made from applet. This field displays error messages if something goes wrong in the transaction between the applet and the switch.
6. Click **Cancel** to return back to the Configuration tab without implementing changes.

8.6.2 Adding a New Ping Test

If the attributes of an existing ping test do not satisfy the requirements of a new connection test, and you do not want to modify an existing test, a new test can be created and added to the list of existing ping tests displayed within the Configuration tab.

To create a new ping test and add it to the list of existing tests:

1. Select **Diagnostics** > **Ping** from the main menu.
2. Click the **Add** button at the bottom of the Configuration tab.



3. Enter the following information to define the properties of the new ping test:

Test Name	Enter a short name for the ping test to describe either the target destination of the ping packet or the ping test's expected result. Use the name provided in combination with the ping test description to convey the overall function of the test.
Description	Ensure the description is representative of the test, as this is the description displaying within the Configuration tab.
Destination IP	Enter the IP address of the target device. This is the numeric (non DNS address) destination for the device transmitted the ping packets.
No. of Probes	Define the number of ping packets transmitted to the target device. This value represents the number of packets transmitted to the target IP address to discern the round trip time between the switch and its connected device.
Timeout(sec)	Configure the timeout value (in seconds) used to timeout the ping test if a round trip packet is not received from the target device. Ensure this interval is long enough to account for network congestion between the switch and its target device.
Frequency	Define the interval (in seconds) between ping packet transmissions. Define a longer interval if high levels of network congestion are anticipated between the switch and its target device. Use a value of 0 to execute a single ping test or stop a currently running ping test.

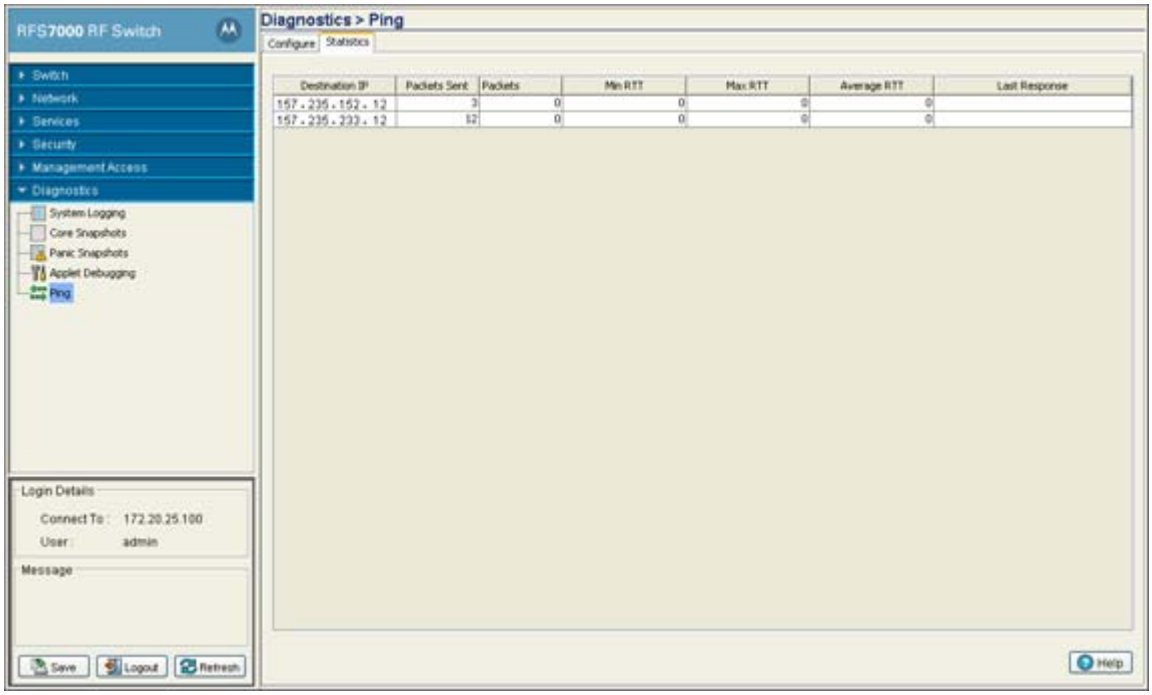
4. Click **OK** to save and add the changes to the running configuration and close the dialog.
5. Refer to the **Status** field for the current state of the requests made from applet. This field displays error messages if something goes wrong in the transaction between the applet and the switch
6. Click **Cancel** to return back to the Configuration tab without implementing changes.

8.6.3 Viewing Ping Statistics

Refer to the **Statistics** tab for an overview of the overall success of the ping test with the destination IP addresses displayed within the screen. Use this information to determine whether the destination IP represents a device offering the switch a viable connection to either extend the switch's existing radio coverage area or provide support for additional MUs within an existing network segment.

To view ping test statistics:

1. Select **Diagnostics** > **Ping** from the main menu.
2. Select the **Statistics** tab.



3. Refer to the following content within the Statistics tab to assess the connection with the target device:

Destination IP	Displays the numeric (non DNS address) destination for the device transmitted the ping packets.
Packets Sent	Displays the number of packets transmitted to the target device IP address. Compare this value with the number of packets received to assess the connection quality with the target device.
Packets Received	Displays the number of packets received from the target device. If this number is significantly lower than the number sent to the target device, consider removing this device from consideration for permanent connection with the switch.

Min RTT	Displays the quickest round trip time for ping packets transmitted from the switch to its destination IP address. This may reflect the time when data traffic was at its lowest for the two devices.
Max RTT	Displays the longest round trip time for ping packets transmitted from the switch to its destination IP address. This may reflect the time when data traffic was at its most congested for the two devices.
Average RTT	Displays the average round trip time for ping packets transmitted between the switch and its destination IP address. Use this value as a general baseline (along with packets sent vs packets received) for the overall connection and association potential between the switch and target device.
Last Response	Displays the time (in seconds) the switch last "heard" the destination IP address over the switch managed network. Use this time (in contention with the RTT values displayed) to determine whether this device warrants a permanent switch connection.

Appendix A

Customer Support

Motorola's Enterprise Mobility Support Center

If you have a problem with your equipment, contact Enterprise Mobility support at *emb.support@motorola.com*

When contacting Enterprise Mobility support, please provide the following information:

- Serial number of the unit
- Model number or product name
- Software type and version number

Motorola responds to calls by email, telephone or fax within the time limits set forth in support agreements. If you purchased your Enterprise Mobility business product from a Motorola business partner, contact that business partner for support.

Customer Support Web Site

Motorola's Support Central Web site, located at *www.symbol.com/support* provides information and online assistance including developer tools, software downloads, product manuals and online repair requests.

Downloads

http://symbol.com/downloads

Manuals

http://symbol.com/manuals

General Information

Obtain additional information by contacting Motorola at:

1-800-722-6234, inside North America

+1-516-738-5200, in/outside North America

http://www.motorola.com/

B.1 Adaptive AP Overview

An *adaptive AP* (AAP) is an AP-51XX access point that can adopt like an AP300 (L3). The management of an AAP is conducted by the switch, once the access point connects to a Motorola WS5100 or RFS7000 model switch and receives its AAP configuration.

An AAP provides:

- local 802.11 traffic termination
- local encryption/decryption
- local traffic bridging
- the tunneling of centralized traffic to the wireless switch.

An AAP's switch connection can be secured using IP/UDP or IPSec depending on whether a secure WAN link from a remote site to the central site already exists.

The switch can be discovered using one of the following mechanisms:

- DHCP
- Switch *fully qualified domain name* (FQDN)
- Static IP addresses.

The benefits of an AAP deployment include:

- *Centralized Configuration Management & Compliance* - Wireless configurations across distributed sites can be centrally managed by the wireless switch or cluster.
- *WAN Survivability* - Local WLAN services at a remote sites are unaffected in the case of a WAN outage.
- *Securely extend corporate WLAN's to stores for corporate visitors* - Small home or office deployments can utilize the feature set of a corporate WLAN from their remote location.
- *Maintain local WLAN's for in store applications* - WLANs created and supported locally can be concurrently supported with your existing infrastructure.

B.1.1 Where to Go From Here

Refer to the following for a further understanding of AAP operation:

- *"B.1.2 Adaptive AP Management"*
- *"B.1.3 Types of Adaptive APs"*
- *"B.1.4 Licensing"*
- *"B.1.5 Switch Discovery"*
- *"B.1.6 Securing a Configuration Channel Between Switch and AP"*
- *"B.1.7 Adaptive AP WLAN Topology"*
- *"B.1.8 Configuration Updates"*
- *"B.1.9 Securing Data Tunnels between the Switch and AAP"*
- *"B.1.10 Adaptive AP Switch Failure"*
- *"B.1.11 Remote Site Survivability (RSS)"*
- *"B.1.12 Adaptive Mesh Support"*

For an understanding of how AAP support should be configured for the access point and its connected switch, see *"B.3 How the AP Receives its Adaptive Configuration"*.

For an overview of how to configure both the access point and switch for basic AAP connectivity and operation, see *"B.4 Establishing Basic Adaptive AP Connectivity"*.

B.1.2 Adaptive AP Management

An AAP can be adopted, configured and managed like a thin access port from the wireless switch.

NOTE	To support AAP functionality, a RFS7000 model switch must be running firmware version 1.1 or higher. The access point must running firmware version 2.0 or higher to be converted into an AAP.

NOTE	An AAP cannot support a firmware download from the wireless switch.

NOTE	Configuration changes made on the AP-5131 will not be updated on the switch. To change the AAP configuration for the AP-5131 make the changes using the switch's interface.

Once an access point connects to a switch and receives its AAP configuration, its WLAN and radio configuration is similar to a thin access port. An AAP's radio mesh configuration can also be configured from the switch. However, non-wireless features (DHCP, NAT, Firewall etc.) cannot be configured from the switch and must be defined using the access point's resident interfaces before its conversion to an AAP.

B.1.3 Types of Adaptive APs

Two low priced AP-5131 SKU configurations are being introduced allowing customers to take advantage of the adaptive AP architecture and to reduce deployment costs.

These dependent mode AP configurations are a software variant of the AP-5131 and will be functional only after the access point is adopted by a wireless switch. After adoption, the dependent mode AP receives its configuration from the switch and starts functioning like other adaptive access points. For ongoing operation, the dependent mode AP-5131 needs to maintain connectivity with the switch. If switch connectivity is lost, the dependent mode AP-5131 continues operating as a stand-alone access point for a period of 3 days before resetting and executing the switch discovery algorithm again.

A dependent mode AP cannot be converted into a standalone AP-51XX through a firmware change. Refer to the *AP-51xx Hardware/ Software Compatibility Matrix* within the release notes bundled with the access point firmware.

AP-5131-13040-D-WR	Dependent AP-5131 Dual Radio (Switch Required)
AP-5131-40020-D-WR	Dependent AP-5131 Single Radio (Switch Required)

B.1.4 Licensing

An AAP uses the same licensing scheme as a thin access port. This implies an existing license purchased with a switch can be used for an AAP deployment. Regardless of how many AP300 and/or AAPs are deployed, you must ensure the license used by the switch supports the number of radio ports (both AP300s and AAPs) you intend to adopt.

B.1.5 Switch Discovery

For an AP-51XX to function as an AAP (regardless of mode), it needs to connect to a switch to receive its configuration. There are two methods of switch discovery:

- *"B.1.5.1 Auto Discovery using DHCP"*
- *"B.1.5.2 Manual Adoption Configuration"*

NOTE To support switch discovery, a RFS7000 model switch must be running firmware version 1.1 or higher. The access point must running firmware version 2.0 or higher.

B.1.5.1 Auto Discovery using DHCP

Extended Global Options 189, 190, 191, 192 can be used or Embedded Option 43 - Vendor Specific options can be embedded in Option 43 using the vendor class identifier: MotorolaAP.51xx-V2-0-0.

	Code	***Data Type***
List of Switch IP addresses *(separate by comma, semi-colon, or space delimited)*	188	String
Switch FQDN	190	String
AP-51XX Encryption IPSec Passphrase (Hashed)**	191	String
AP-51XX switch discovery mode 1 = auto discovery enable 2 = auto discover enabled (using IPSec)	192	String

** The AP-51xx uses an encryption key to hash passphrases and security keys. To obtain the encryption passphrase, configure an AP-51xx with the passphrase and export the configuration file.

```
/
enc-admin-passwd d2
/
// System Configuration
/
system
set name AP-51xx
set loc \0
set email \0
set cc us
/
system
aap-setup
// Adaptive AP menu
set auto-discovery disable
set interface lan1
set name \0
set port 24576
delete all
set enc-passphrase bf0819993a702c39
set ac-keepalive 5
set tunnel-to-switch enable
/
// System-Access menu
system
access
set applet lan 1 enable
set applet slan 1 enable
set cli lan 1 enable
set ssh lan 1 enable
set snmp lan 1 enable
```

Encrypted Passphrase to be used in DHCP Option

B.1.5.2 Manual Adoption Configuration

A manual switch adoption of an AAP can be conducted using:

- *Static FQDN* - A switch fully qualified domain name can be specified to perform a DNS lookup and switch discovery.
- *Static IP addresses* - Up to 12 switch IP addresses can be manually specified in an ordered list the AP can choose from. When providing a list, the AAP tries to adopt based on the order in which they are listed (from 1-12).

NOTE An AAP can use it's LAN or WAN Ethernet interface to adopt. The LAN is PoE and DHCP enabled by default.

The WAN has no PoE support and has a default static AP address of 10.1.1.1/8.

B.1.6 Securing a Configuration Channel Between Switch and AP

Once an access point obtains a list of available switches, it begins connecting to each. The switch can be either on the LAN or WAN side of the access point to provide flexibility in the deployment of the network. If the switch is on the access point's LAN, ensure the LAN subnet is on a secure channel. The AP will connect to the switch and request a configuration.

B.1.7 Adaptive AP WLAN Topology

An AAP can be deployed in the following WLAN topologies:

- *Extended WLANs* - Extended WLANs are the centralized WLANs created on the switch
- *Independent WLANs* - Independent WLANs are local to an AAP and can be configured from the switch. You must specify a WLAN as independent to stop traffic from being forwarded to the switch. Independent WLANs behave like WLANs on a standalone access point.
- *Both* - Extended and independent WLANs are configured from the switch and operate simultaneously.

NOTE For a review of some important considerations impacting the use of extended and independent WLANs within an AAP deployment, see *"B.4.3 Adaptive AP Deployment Considerations"*.

B.1.8 Configuration Updates

An AAP receives its configuration from the switch initially as part of its adoption sequence. Subsequent configuration changes on the switch are reflected on an AAP when applicable.

An AAP applies the configuration changes it receives from the switch after 30 seconds from the last received switch configuration message. When the configuration is applied on the AAP, the radios shutdown and re-initialize (this process takes less than 2 seconds) forcing associated MUs to be deauthenticated. MUs are quickly able to associate.

B.1.9 Securing Data Tunnels between the Switch and AAP

If a secure link (site-to-site VPN) from a remote site to the central location already exists, the AAP does not require IPSec be configured for adoption.

For sites with no secure link to the central location, an AAP can be configured to use an IPSec tunnel (with AES 256 encryption) for adoption. The tunnel configuration is automatic on the AAP side and requires no manual VPN policy be configured. On the switch side, configuration updates are required to adopt the AAP using an IPSec tunnel.

To review a sample AAP configuration, see *"B.4.4. Sample Switch Configuration File for IPSec and Independent WLAN"* .

B.1.10 Adaptive AP Switch Failure

In the event of a switch failure, an AAP's independent WLAN continues to operate without disruption. The AAP attempts to connect to other switches (if available) in background. Extended WLANs are disabled once switch adoption is lost. When a new switch is discovered and a connection is secured, an extended WLAN can be enabled.

If a new switch is located, the AAP synchronizes its configuration with the located switch once adopted. If *Remote Site Survivability* (RSS) is disabled, the independent WLAN is also disabled in the event of a switch failure.

B.1.11 Remote Site Survivability (RSS)

RSS can be used to turn off RF activity on an AAP if it loses adoption (connection) to the switch.

RSS State	*Independent WLANs*	*Extended WLANs*
RSS Enabled	WLAN continues beaconing	WLAN continues beaconing but AP does allow clients to associate on that WLAN
RSS Disabled	WLAN stops beaconing	WLAN stops beaconing

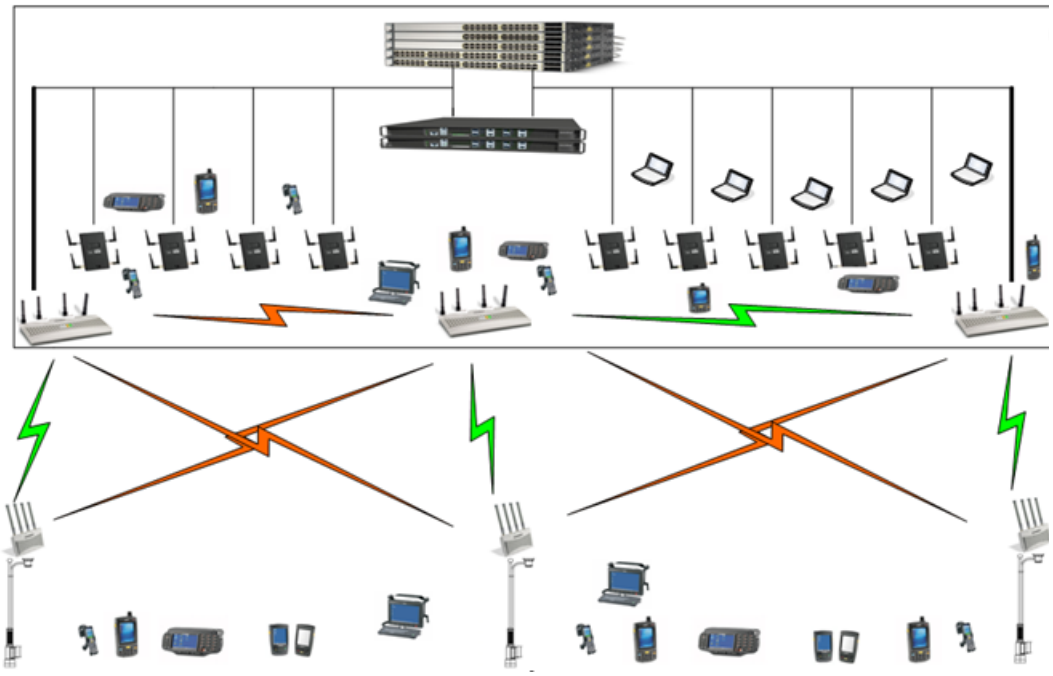
NOTE For a dependant AAP, independent WLANs continue to beacon for three days in the absence of a switch.

B.1.12 Adaptive Mesh Support

An AAP can extend an AP51x1's existing mesh functionality to a switch managed network. All mesh APs are configured and managed through the wireless switch. APs without a wired connection form a mesh backhaul to a repeater or a wired mesh node and then get adopted to the switch. Mesh nodes with existing wired access get adopted to the switch like a wired AAP.

Mesh AAPs apply configuration changes 300 seconds after the last received switch configuration message. When the configuration is applied on the Mesh AAP, the radios shutdown and re-initialize (this process takes less than 2 seconds), forcing associated MUs to be deauthenticated and the Mesh link will go down. MUs are able to quickly associate, but the Mesh link will need to be re-established before MUs can pass traffic. This typically takes about 90 to 180 seconds depending on the size of the mesh topology.

NOTE When mesh is used with AAPs, the "ap-timeout" value needs to be set to a higher value (for example, 180 seconds) so Mesh AAPs remain adopted to the switch during the period when the configuration is applied and mesh links are re-established.



B.2 Supported Adaptive AP Topologies

The following AAP topologies are supported with the RFS7000:

- *"B.2.2 Extended WLANs Only"*
- *"B.2.3 Independent WLANs Only"*
- *"B.2.3 Extended WLANs with Independent WLANs"*
- *"B.2.4 Extended VLAN with Mesh Networking"*

B.2.1 Topology Deployment Considerations

When reviewing the AAP topologies describes in the section, be cognizant of the following considerations to optimize the effectiveness of the deployment:

- An AAP firmware upgrade will not be performed at the time of adoption from the wireless switch. Instead, the firmware is upgraded using the AP-51x1's firmware update procedure (manually or using the DHCP Auto Update feature).
- An AAP can use its LAN1 interface or WAN interface for adoption. The default gateway interface is set to LAN1. If the WAN Interface is used, explicitly configure WAN as the default gateway interface.
- Motorola recommends using the LAN1 interface for adoption in multi-cell deployments.
- If you have multiple independent WLANs mapped to different VLANs, the AAP's LAN1 interface requires trunking be enabled with the correct management and native VLAN IDs configured. Additionally, the AAP needs to be connected to a 802.1q trunk port on the wired switch.
- Be aware IPSec Mode supports NAT Traversal (NAT-T).

B.2.2 Extended WLANs Only

An extended WLAN configuration forces all MU traffic through the switch. No wireless traffic is locally bridged by the AAP.

Each extended WLAN is mapped to the access point's virtual LAN2 subnet. By default, the access point's LAN2 is not enabled and the default configuration is set to static with IP addresses defined as all zeros. If the extended VLAN option is configured on the switch, the following configuration updates are made automatically:

- The AAP's LAN2 subnet becomes enabled
- All extended VLANs are mapped to LAN2.

NOTE MUs on the same WLAN associated to the AAP can communicate locally at the AP Level without going through the switch. If this scenario is undesirable, the access point's MU-to-MU disallow option should be enabled.

B.2.3 Independent WLANs Only

An independent WLAN configuration forces all MU traffic be bridged locally by the AAP. No wireless traffic is tunneled back to the switch. Each extended WLAN is mapped to the access point's LAN1 interface. The only traffic between the switch and the AAP are control messages (for example, heartbeats, statistics and configuration updates).

B.2.3 Extended WLANs with Independent WLANs

An AAP can have both extended WLANs and independent WLANs operating in conjunction. When used together, MU traffic from extended WLANs go back to the switch and traffic from independent WLANs is bridged locally by the AP.

All local WLANs are mapped to LAN1, and all extended WLANs are mapped to LAN2.

B.2.4 Extended VLAN with Mesh Networking

Mesh networking is an extension of the existing wired network. There is no special configuration required, with the exception of setting the mesh and using it within one of the two extended VLAN configurations.

NOTE The mesh backhaul WLAN must be an independent WLAN mapped to LAN2. The switch enforces the WLAN be defined as an independent WLAN by automatically setting the WLAN to independent when backhaul is selected. The AP ensures the backhaul WLAN be put on LAN1.

B.3 How the AP Receives its Adaptive Configuration

An AAP does not require a separate "local" or "running" configuration. Once enabled as an AAP, the AP obtains its configuration from the switch. If the AP's WAN link fails, it continues to operate using the last valid configuration until its link is re-established and a new configuration is pushed down from the switch. There is no separate file-based configuration stored on the switch.

Only WLAN, VLAN extension and radio configuration items are defined for the AAP by its connected switch. None of the other access point configuration items (RADIUS, DHCP, NAT, Firewall etc.) are configurable from the connected switch.

After the AP downloads a configuration file from the switch, it obtains the version number of the image it should be running. The switch does not have the capacity to hold the access point's firmware image and configuration. The access point image must be downloaded using a means outside the switch. If there is still an image version mismatch between what the switch expects and what the AAP is running, the switch will deny adoption.

B.3.1 Adaptive AP Pre-requisites

Converting an AP-5131 or AP-5181 model access point into an AAP requires:

- A version 2.0 or higher firmware running on the access point.
- A RFS7000 (running firmware version 1.1 or later) model switch.
- The appropriate switch licenses providing AAP functionality on the switch.
- The correct password to authenticate and connect the adaptive to the switch.

B.3.2 Configuring the Adaptive AP for Adoption by the Switch

1. An AAP needs to find and connect to the switch. To ensure this connection:
   - Configure the switch's IP address on the AAP
   - Provide the switch IP address using DHCP option 189 on a DHCP server. The IP address is a comma delimited string of IP addresses. For example "157.235.94.91, 10.10.10.19". There can be a maximum of 12 IP addresses.
   - Configure the switch's FQDN on the AAP. The AAP can use this to resolve the IP address of the switch.
2. Use the switch's secret password on the AAP for the switch to authenticate it.

To avoid a lengthy broken connection with the switch, Motorola recommends generating an SNMP trap when the AAP loses adoption with the switch.

NOTE For additional information (in greater detail) on the AP configuration activities described above, see *"B.4.1 Adaptive AP Configuration"*.

B.3.3 Configuring the Switch for Adaptive AP Adoption

The tasks described below are configured on a RFS7000 model switch. For information on configuring the switch for AAP support, see *http://support.symbol.com/support/product/manuals.do*.

To adopt an AAP on a switch:

1. Ensure enough licenses are available on the switch to adopt the required number of AAPs.
2. As soon as the AAP displays in the adopted list:

   Adjust each AAP's radio configuration as required. This includes WLAN-radio mappings and radio parameters. WLAN-VLAN mappings and WLAN parameters are global and cannot be defined on a per radio basis. WLANs can be assigned to a radio as done today for an AP300 model access port. Optionally, configure WLANs as independent and assign to AAPs as needed.
3. Configure each VPN tunnel with the VLANs to be extended to it.

   If you do not attach the target VLAN, no data will be forwarded to the AAP, only control traffic required to adopt and configure the AP.

NOTE For additional information (in greater detail) on the switch configuration activities described above, see *"B.4.2 Switch Configuration"*.

B.4 Establishing Basic Adaptive AP Connectivity

This section defines the activities required to configure basic AAP connectivity with a RFS7000 model switch. In establishing a basic AAP connection, both the access point and switch require modifications to their respective default configurations. For more information, see:

- *"B.4.1 Adaptive AP Configuration"*
- *"B.4.2 Switch Configuration"*

NOTE Refer to *"B.4.3 Adaptive AP Deployment Considerations"* for usage and deployment caveats that should be considered before defining the AAP configuration. Refer to *"B.4.4. Sample Switch Configuration File for IPSec and Independent WLAN"* if planning to deploy an AAP configuration using IPSec VPN and an extended WLAN.

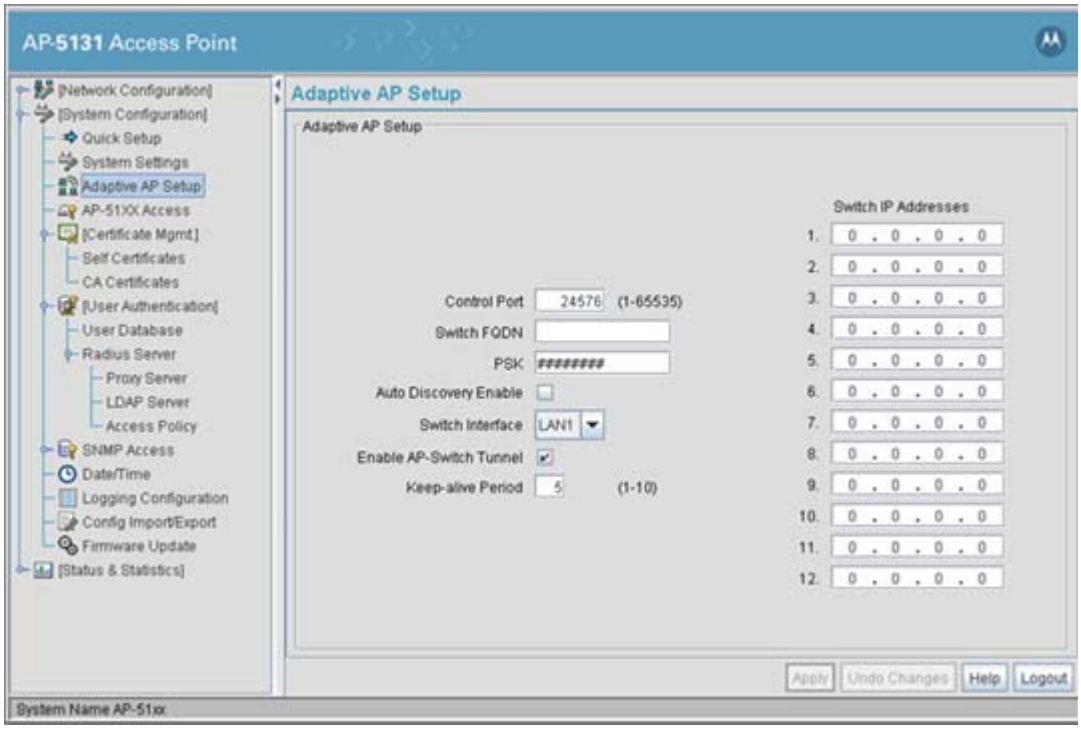
B.4.1 Adaptive AP Configuration

An AAP can be manually adopted by the switch, adopted using a configuration file (consisting of the adaptive parameters) pushed to the access point or adopted using DHCP options. Each of these adoption techniques is described in the sections that follow.

B.4.1.1 Adopting an Adaptive AP Manually

To manually enable the access point's switch discovery method and connection medium required for adoption:

1. Select **System Configuration** -> **Adaptive AP Setup** from the access point's menu tree.



2. Select the **Auto Discovery Enable** checkbox.

   Enabling auto discovery will allow the AAP to be detected by a switch once its connectivity medium has been configured (by completing steps 3-6).

NOTE Auto discovery must be enabled for a switch to detect an AP.

3. Enter up to 12 **Switch IP Addresses** constituting the target switches available for AAP connection.

   The AAP will begin establishing a connection with the first addresses in the list. If unsuccessful, the AP will continue down the list (in order) until a connection is established.

4. If a numerical IP address is unknown, but you know a switch's *fully qualified domain name* (FQDN), enter the name as the **Switch FQDN** value.

5. Select the **Enable AP-Switch Tunnel** option to allow AAP configuration data to reach a switch using a secure VPN tunnel.
6. If using IPSec as the tunnel resource, enter the IPSec **Passkey** to ensure IPSec connectivity.
7. Click **Apply** to save the changes to the AAP setup.

NOTE The manual AAP adoption described above can also be conducted using the access point's CLI interface using the *admin(system.aapsetup)>* command.

B.4.1.2 Adopting an Adaptive AP Using a Configuration File

To adopt an AAP using a configuration file:

1. Refer to *"B.4.1.1 Adopting an Adaptive AP Manually"* and define the AAP switch connection parameters.
2. Export the AAP's configuration to a secure location.

   Either import the configuration manually to other APs or the same AP later (if you elect to default its configuration). Use DHCP option 186 and 187 to force a download of the configuration file during startup (when it receives a DHCP offer).

B.4.1.3 Adopting an Adaptive AP Using DHCP Options

An AAP can be adopted to a wireless switch by providing the following options in the DHCP Offer:

Option	*Data Type*	*Value*
189	String	<Switch IP Address or Range of IP addresses separated by [, ; <space>]>
190	String	<Fully qualified Domain Name for the Wireless Switch>
191	String	<Hashed IPSec Passkey - configure on 1 AP and export to get hashed key>
192	String	<Value of "1" denotes Non-IPSec Mode and "2" denotes IPSec Mode>

NOTE Options 189 and 192 are mandatory to trigger adoption using DHCP options. Unlike an AP300, option 189 alone won't work. These options can be embedded in Vendor Specific Option 43 and sent in the DHCP Offer.

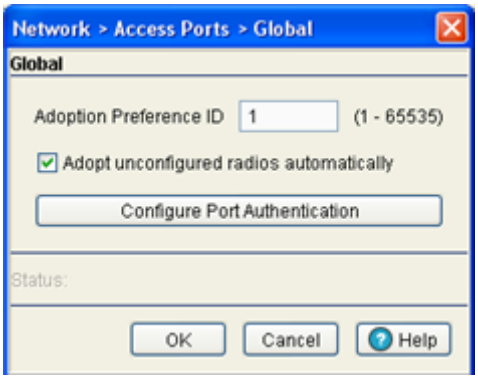
B.4.2 Switch Configuration

A RFS7000 (running firmware version 1.1 or later) requires an explicit adaptive configuration to adopt an access point (if IPSec is not being used for adoption). The same licenses currently used for AP300 adoption can be used for an AAP.

Disable the switch's **Adopt unconfigured radios automatically** option and manually add AAPs requiring adoption, or leave as default. In default mode, any AAP adoption request is honored until the current switch license limit is reached.

To disable automatic adoption on the switch:

1. Select **Network** > **Access Port Radios** from the switch main menu tree.
2. Select the **Configuration** tab (should be displayed be default) and click the **Global Settings** button.



3. Ensure the **Adopt unconfigured radios automatically** option is NOT selected.

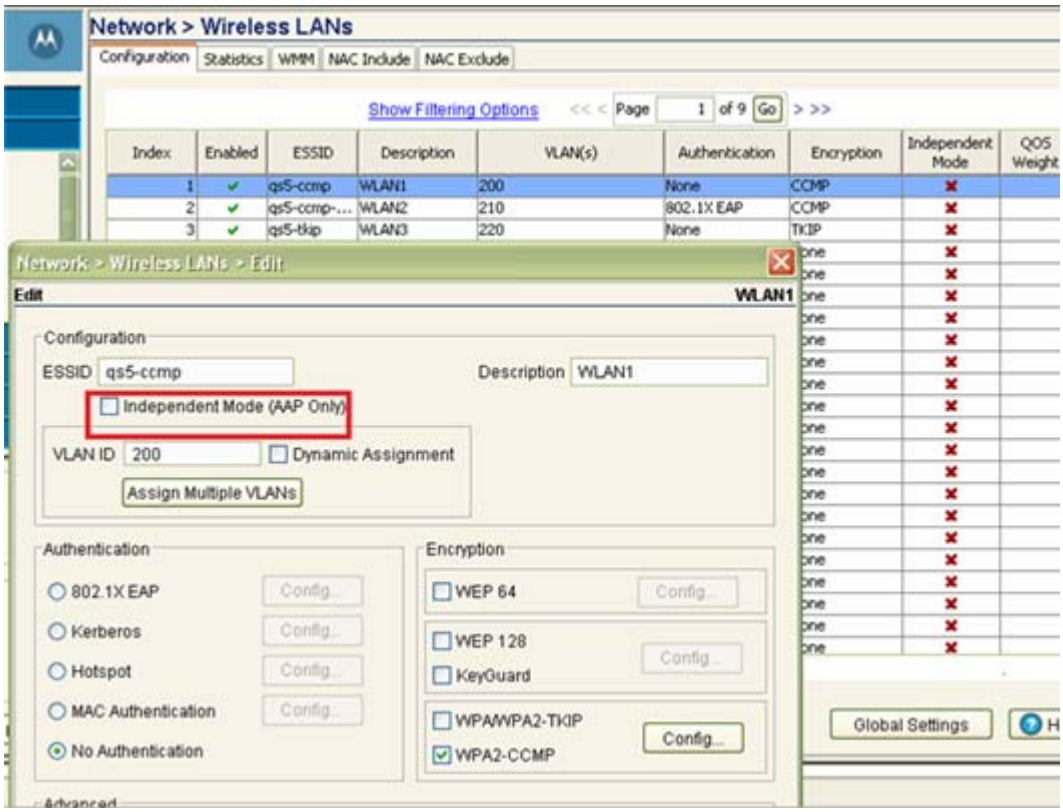
   When disabled, there is no automatic adoption of non-configured radios on the network. Additionally, default radio settings will NOT be applied to access ports when automatically adopted.

NOTE For IPSec deployments, refer to *"B.4.4. Sample Switch Configuration File for IPSec and Independent WLAN"* and take note of the CLI commands in red and associated comments in green.

   Any WLAN configured on the switch becomes an extended WLAN by default for an AAP.

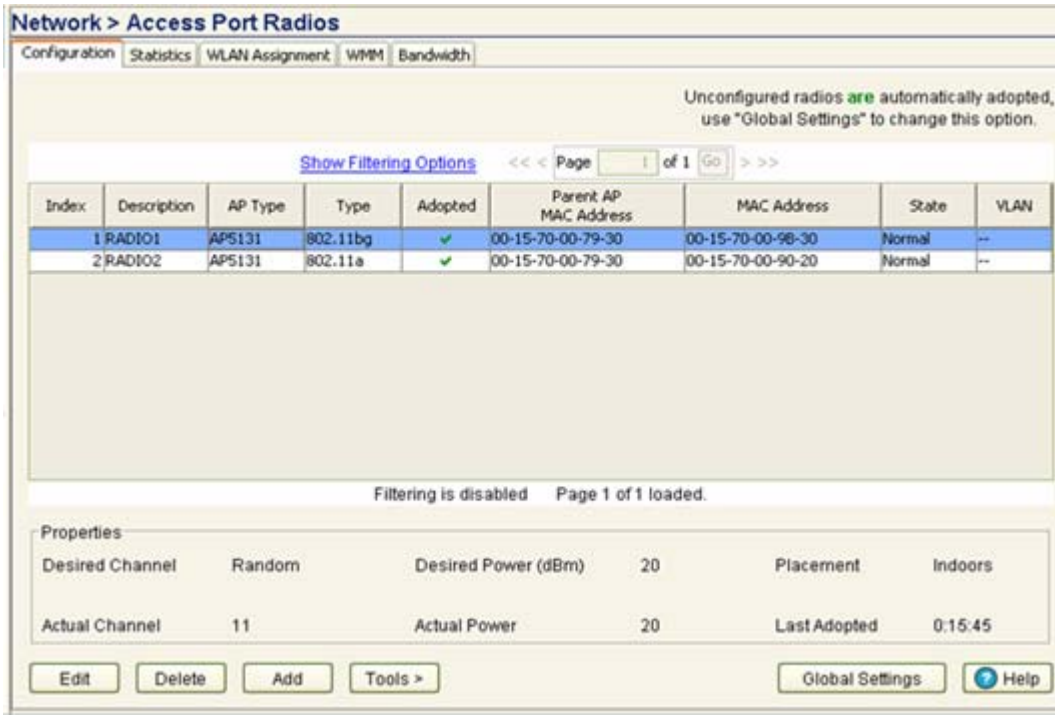
4. Select **Network** > **Wireless LANs** from the switch main menu tree.
5. Select the target WLAN you would like to use for AAP support from those displayed and click the **Edit** button.
6. Select the **Independent Mode (AAP Only)** checkbox.

   Selecting the checkbox designates the WLAN as independent and prevents traffic from being forwarded to the switch. Independent WLANs behave like WLANs as used on a a standalone access point. Leave this option unselected (as is by default) to keep this WLAN an extended WLAN (a typical centralized WLAN created on the switch).



NOTE Additionally, a WLAN can be defined as independent using the "*wlan <index> independent*" command from the config-wireless context.

Once an AAP is adopted by the switch, it displays within the switch **Access Port Radios** screen (under the Network parent menu item) as an AP-5131 or AP-5181 within the **AP Type** column.



B.4.3 Adaptive AP Deployment Considerations

Before deploying your switch/AAP configuration, refer to the following usage caveats to optimize its effectiveness:

- Extended WLANs are mapped to the AP's LAN2 interface and all independent WLANs are mapped to the AP's LAN1 Interface.
- If deploying multiple independent WLANs mapped to different VLANs, ensure the AP's LAN1 interface is connected to a trunk port on the L2/L3 switch and appropriate management and native VLANs are configured.
- The WLAN used for mesh backhaul must always be an independent WLAN.
- The switch configures an AAP. If manually changing wireless settings on the AP, they are not updated on the switch. It's a one way configuration, from the switch to the AP.
- An AAP always requires a router between the AP and the switch.
- An AAP can be used behind a NAT.
- An AAP uses UDP port 24576 for control frames and UDP port 24577 for data frames.
- Multiple VLANs per WLAN, L3 mobility, dynamic VLAN assignment, NAC, self healing, rogue AP, MU locationing, hotspot on extended WLAN are some of the important wireless features not supported in an AAP supported deployment.

B.4.4. Sample Switch Configuration File for IPSec and Independent WLAN

The following constitutes a sample RFS7000 switch configuration file supporting an AAP IPSec with Independent WLAN configuration. Please note new AAP specific CLI commands in red and relevant comments in blue.

The sample output is as follows:

```
!
! configuration of RFS7000 RFS7000-1 version 1.1.0.0-016D
!
version 1.0
!
!
aaa authentication login default none
service prompt crash-info
!
hostname RFS7000-1
!
username admin password 1 8e67bb26b358e2ed20fe552ed6fb832f397a507d
username admin privilege  superuser
username operator password 1 fe96dd39756ac41b74283a9292652d366d73931f
!
!
To configure the ACL to be used in the CRYPTO MAP
!
ip access-list extended AAP-ACL permit ip host 10.10.10.250 any rule-precedence 20
!
spanning-tree mst cisco-interoperability enable
spanning-tree mst config
name My Name
!
country-code us
logging buffered 4
logging console 7
logging host 157.235.92.97
logging syslog 7
snmp-server sysname RFS7000-1
snmp-server manager v2
snmp-server manager v3
snmp-server user snmptrap v3 encrypted auth md5 0x7be2cb56f6060226f15974c936e2739b
snmp-server user snmpmanager v3 encrypted auth md5 0x7be2cb56f6060226f15974c936e2739b
snmp-server user snmpoperator v3 encrypted auth md5 0x49c451c7c6893ffcede0491bbd0a12c4
!
To configure the passkey for a Remote VPN Peer - 255.255.255.255 denotes all AAPs. 12345678 is the
default passkey. If you change on the AAP, change here as well.
!
crypto isakmp key 0 12345678 address 255.255.255.255
```

```
!
ip http server
ip http secure-trustpoint default-trustpoint
ip http secure-server
ip ssh
no service pm sys-restart
timezone America/Los_Angeles
license AP
xyxyxyxyxyxyxyxyxyxyxyxyxyxyxyxyxyxyxyxyxyxyxyxyxyxyxyxyxyxyxyxyxyxyxyxyxyxyxyxyxyxyxyxyxyxyxyxyxyxyxyxyxyx
!

wireless
   no adopt-unconf-radio enable
   manual-wlan-mapping enable
   wlan 1 enable
   wlan 1 ssid qs5-ccmp
   wlan 1 vlan 200
   wlan 1 encryption-type ccmp
   wlan 1 dot11i phrase 0 Symbol123
   wlan 2 enable
   wlan 2 ssid qs5-tkip
   wlan 2 vlan 210
   wlan 2 encryption-type tkip
   wlan 2 dot11i phrase 0 Symbol123
   wlan 3 enable
   wlan 3 ssid qs5-wep128
   wlan 3 vlan 220
   wlan 3 encryption-type wep128
   wlan 4 enable
   wlan 4 ssid qs5-open
   wlan 4 vlan 230
   wlan 5 enable
   wlan 5 ssid Mesh
   wlan 5 vlan 111
   wlan 5 encryption-type ccmp
   wlan 5 dot11i phrase 0 Symbol123
   !
   To configure a WLAN as an independent WLAN
   !
   wlan 5 independent
   wlan 5 client-bridge-backhaul enable
   wlan 6 enable
   wlan 6 ssid test-mesh
   wlan 6 vlan 250
   radio add 1 00-15-70-00-79-30 11bg aap5131
   radio 1 bss 1 3
   radio 1 bss 2 4
   radio 1 bss 3 2
   radio 1 channel-power indoor 11 8
```

```
   radio 1 rss enable
   radio add 2 00-15-70-00-79-30 11a aap5131
   radio 2 bss 1 5
   radio 2 bss 2 1
   radio 2 bss 3 2
   radio 2 channel-power indoor 48 8
   radio 2 rss enable
   radio 2 base-bridge max-clients 12
   radio 2 base-bridge enable
   radio add 3 00-15-70-00-79-12 11bg aap5131
   radio 3 bss 1 3
   radio 3 bss 2 4
   radio 3 bss 3 2
   radio 3 channel-power indoor 6 8
   radio 3 rss enable
   radio add 4 00-15-70-00-79-12 11a aap5131
   radio 4 bss 1 5
   radio 4 bss 2 6
   radio 4 channel-power indoor 48 4
   radio 4 rss enable
   radio 4 client-bridge bridge-select-mode auto
   radio 4 client-bridge ssid Mesh
   radio 4 client-bridge mesh-timeout 0
   radio 4 client-bridge enable
   radio default-11a rss enable
   radio default-11bg rss enable
   radio default-11b rss enable
   no ap-ip default-ap switch-ip
!
radius-server local
!
To create an IPSEC Transform Set
!
crypto ipsec transform-set AAP-TFSET esp-aes-256 esp-sha-hmac mode tunnel
!
To create a Crypto Map, add a remote peer, set the mode, add a ACL rule to match and transform and
set to the Crypto Map
!
crypto map AAP-CRYPTOMAP 10 ipsec-isakmp
set peer 255.255.255.255
set mode aggressive
match address AAP-ACL
set transform-set AAP-TFSET
!
interface ge1
switchport mode trunk
switchport trunk native vlan 1
switchport trunk allowed vlan none
```

```
switchport trunk allowed vlan add 1-9,100,110,120,130,140,150,160,170,
switchport trunk allowed vlan add 180,190,200,210,220,230,240,250,
static-channel-group 1
!
interface ge2
switchport access vlan 1
!
interface ge3
switchport mode trunk
switchport trunk native vlan 1
switchport trunk allowed vlan none
switchport trunk allowed vlan add 1-9,100,110,120,130,140,150,160,170,
switchport trunk allowed vlan add 180,190,200,210,220,230,240,250,
static-channel-group 1
!
interface ge4
switchport access vlan 1
!
interface me1
ip address dhcp
!
interface sa1
switchport mode trunk
switchport trunk native vlan 1
switchport trunk allowed vlan none
switchport trunk allowed vlan add 1-9,100,110,120,130,140,150,160,170,
switchport trunk allowed vlan add 180,190,200,210,220,230,240,250,
!
!
!
!
interface vlan1
ip address dhcp
!
To attach a Crypto Map to a VLAN Interface
!
crypto map AAP-CRYPTOMAP
!
sole
!
ip route 157.235.0.0/16 157.235.92.2
ip route 172.0.0.0/8 157.235.92.2
!
ntp server 10.10.10.100 prefer version 3

line con 0
line vty 0 24
!
end
```

MOTOROLA INC.
1303 E. ALGONQUIN ROAD
SCHAUMBURG, IL 60196
http://www.motorola.com

72E-103889-01 Revision A
January 2008